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THE GEOGRAPHICAL JOURNAL

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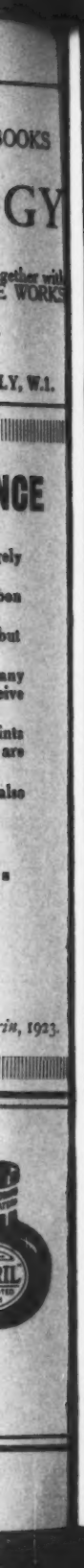


The Geographical Journal

Vol. LXIV No. 5 November 1924

THROUGH KUFRA TO DARFUR

A. M. Hassanein Bey

(*Continued from p.* 291.)

ON April 18 the caravan was ready to start, and a number of *Ikhwan* and Badawi chiefs came to see us off. My men were greeted by their friends as though this was to be their last meeting. It was the most touching farewell of the whole journey. "May God make safety your companion. What is decreed is decreed and that will happen. May God guide you to the true road and protect you from evil." These last words were spoken with a few quivers, and knowing what had passed in the preceding days, and the intimidation to which the men had been subjected, I could guess what was in their minds.

We crossed the southern fringe of the Kufra Valley and were soon in the open, in country of hard sand covered with fine gravel.

On April 20, passing through undulating country strewn with stone, we saw a swallow in the morning and a hawk in the afternoon. This was the worst part of the journey for travelling, so far as temperature conditions were concerned. Too hot to march in the middle of the day, at night it was too cold. So we broke the trek into two parts, starting soon after midnight and resting in the heat of the day. Sometimes the men had little sleep and were very tired after sunrise, but it was chiefly the intense heat from noon to four o'clock that exhausted both men and camels. On April 22 we found the flat hard sand varied by occasional sand hillocks, 3 to 10 metres high, covered with black stones, and at 5.30 a.m. we sighted a chain of hills on our left running from north to south-west across our path. We then entered a broken, hilly country which continued all day. It is called Wadi El Mahareeg. On this day we came across some broken ostrich eggs, and Bukara, one of the men of my caravan, brought me two little eagles, which I ordered him to restore to the nest where he had found them.

On April 23 at 5.30 a.m. we reached high, steep sand-dunes, which were dangerous for the camels. We had to tackle them carefully, and we lost much time in crossing them. Directly after the dunes we passed on our left Gour Forau and sighted the mountains of Arkenu stretched across our way. This was the most exhausting trek I had known. For

eight days we had only four hours of sleep a day, and hardly had we started before the men with one accord would fall back to snatch half an hour's sleep, leaving the camels to follow the will-o'-the-wisp of the guide's lantern. My anxiety for my instruments prevented me from availing myself of this privilege, for the loading, done in the dark, was insecure, and a slipped fastening may mean a broken instrument or camera.

We were having a hard time of it crossing the high, steep sand-dunes when suddenly the mountains rose before us like mediæval castles half hidden in the morning mist. A few minutes later the sun turned the cold grey into warm rose and pink. On April 24 we made 37 kilometres over broken country. North of Arkenu mountain, and only 100 metres from it, is a big sandstone hill about 2 kilometres long and 100 metres or so high. Arkenu mountain is a mass of granite, its surface weathered to a ruddy brown, rising jaggedly along its length up to 500 metres from the desert surface. It is made up of a series of conical masses which run together at their feet, without intervals between them. We approached it at its most western point. At the farthest point that we could see to the east it rose into a peak. Marching around the north-western corner of the mass, we came to the entrance of a valley running eastward. A single tree of the species which the Goran call Arkenu stands in the desert near the mouth of the valley, and from it the oasis takes its name. We made our camp near it, and sent the camels into the valley to be watered and to bring back the supply of water of which we were much in need.

Goran, black tribesmen of the neighbourhood, suddenly appeared, and were kept to dine with my men. No one had dreamed of their presence until they appeared. The mountain looks desolate and deserted, and one would not suspect that within there lies a fertile valley that is inhabited. Arkenu is not, in fact, inhabited all the year round. The Badawi, Tebus, and Goran bring their camels during the grazing season, close the entrances to the valley with rocks, and leave the camels there unattended for three months.

Arkenu was the first of the two " lost " oases which it was my good fortune to place upon the map. The water at Arkenu is apparently unfailing and is drinkable, though not as wholesome for human beings as one could wish. Arkenu may conceivably prove to have some strategic value at some future time, standing as it does almost precisely at the meeting-point of the western and southern boundaries of Egypt.

On April 28 we started on our first all-night trek. A night march has its advantages. The time, unless one is dead tired, passes more quickly than during the day, and the stars are cheering company for any lover of nature. On the horizon ahead of us loomed the dark masses of the Owenat Mountains. It is so much easier to march with one's destination distinct before one than to be walking on that flat disc of a desert

where very point of the compass looks like every other and the horizon keeps always at the same maddening distance. As we drew near the sun rose over the mountains, gilding their peaks and throwing across the desert a heavy shadow whose edge marched steadily towards the mountain foot as we approached it from another direction. We camped close under the north-west corner of the mountains, where there is an indentation in the mountain side, with a well in a cave at its inner end. At this point the mountain rises in a sheer cliff, with a mass of boulders, great and small, heaped against it at its foot. The stones that make up this talus have been carved by ages of wind and driven sand—maybe by rain as well—into smooth rounded shapes that giants of the heroic days might have used in their slings to kill monsters. The *ain*, or spring, lies in a cavity walled and roofed with the great rocks. The water is kept cool by their protection from the sun. The *ain* is in this case more correctly a reservoir in the rock where rain-water collects.

The next morning early we undertook a stiff climb of an hour and a half to the big *ain* up in the mountain. It has a plentiful supply of splendid water, and is surrounded with tall slim reeds. In the early evening we set out to explore the oasis, and at midnight entered a valley with a chain of low hills on our left and the mountain with its fantastic rock formations on our right. The valley is floored with soft sand strewn with big stones which makes hard going for the camels. After a stop at dawn for morning prayers and a glass of tea, seven o'clock found us entering a wide valley, running a little east of south, with mountains rising high on both sides. The floor of the valley was flat as a table, patterned with tufts of grass and marked here and there with mimosa trees and small shrubs, whose leaves when crushed give off a fragrance similar to that of mint. At intervals the ground is carpeted with creeping plants of the colocynth, expanses of green leaves dotted with brilliant yellow globes like grape-fruit. From this fruit the Tebus and Goran make *abra*. They boil the pips thoroughly to get rid of their bitter taste, and then crush them with dates or locusts in a wooden mortar. This is their staple dish.

At 10 a.m. we camped. After sleeping and eating, I went to see some relics of the presence of men here in an earlier time. On a wall of rock there are pictures of animals, rudely drawn but not unskilfully carved. There are lions, giraffes, and ostriches, all kinds of gazelle, and perhaps cows, though many of these figures have been effaced by time. The carving is from a quarter to half an inch in depth, and the edges of the lines are weathered until in some parts they can be scraped off easily with the finger. I could find no traditions about the origin of these rock markings, but I was struck by two things. There are no giraffes in this part of the country now, nor can they live in similar desert country anywhere. Also there are no camels among the carvings, and one cannot penetrate to this oasis now except with camels. Did the men

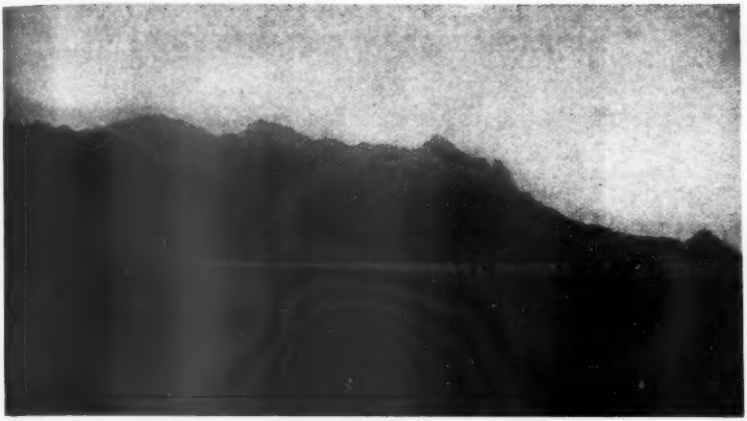
who made these pictures know the giraffe and not the camel? The camel came to Africa from Asia some 500 years B.C. The only game I came across at Owenat was the wild sheep, gazelle, and small fox with a greyish coat.

We returned to camp on the morning of May 2, and found Sheikh Herri awaiting us. He is the Goran chief who is called "King" of Owenat and its 150 inhabitants. Subsequently I arranged with him to accompany us to Erdi as an additional guide, and we set forth at 6.45 p.m. on the evening of Sunday May 6 over flat country, hard sand covered with gravel. In some stretches large stones made going difficult. A few patches of dried grass provided grazing for the camels. We made a good twelve hours' trek of 54 kilometres.

On May 29 Muhammad wanted us to make an early start, as there was a difficult *gherd* ahead which could not be crossed in the dark, so 4.15 p.m. found us under way, with *serira* underfoot and a cool north-east wind behind us. Shortly after 8 I felt the wind in my face. I was startled, for the wind does not usually shift so suddenly, nor had its quality changed. The sky was completely covered with dark clouds, but with my compass I found that we were heading full north-east instead of south-west. Clearly Sukkar, our guide, had "lost his head," as the Badawi say. It was a situation that required careful handling, for it is dangerous to undermine a desert guide's confidence. To add to our difficulties a sandstorm which had been rising blew out his lantern. By this time the caravan, men and camels, was all huddled together, the gale and hurtling sand beating upon it, and every one realised that we had lost our way. Sooner than halt I decided to rely on my compass, which I had checked many times with the directions pointed out by Herri. We lit the lantern again with difficulty and I led the way. A few hours later the storm subsided completely, and we found ourselves among the sand-dunes. This little experience demonstrates what a touch-and-go business desert trekking can be at times.

Early in the morning of May 10 we got under way to cross the *gherds*, and realized how serious a mistake it would have been to tackle them in the darkness. They were very steep and the sand treacherously soft. The camels sank to their knees and had to be helped by the men.

On May 12 we started at 5.30 p.m. and made 70 kilometres. Our way lay across *serira*, with a chain of hills 50 to 100 metres high on our left a few kilometres away. Herri indicated the north-west corner of the chain of hills as our goal. We reached it at 9.45 a.m. the following morning and pitched camp. The camels were sent into the hills to graze. In the afternoon Sukkar and Herri went ahead into the hills to make a track in the sand with a tent-pole for us to follow. At 5 p.m. we set forth into the sand-hills and thence into the hills. The *gherds* were fortunately not many, though steep enough, but it was the hilly country beyond that proved exhausting. Our feet kept bumping



THE HILLS OF ARKENU

THE HILLS OF OWENAT

THE DESERT FROM OWENAT

THE WELL AT OWENAT

CAMP KITCHEN AT OWENAT

into stones in the dark, and Badawi shoes are little protection against such painful encounters. The collisions were particularly numerous in the early morning hours when we were terribly sleepy and walked with eyes half shut. At dawn we halted for morning prayers. We had barely risen from our knees when most of the men wrapped themselves in their *jerds* and fell on the red sand like so many white stones.

On the 13th the country became more undulating and broken, and both camels and men found the going disastrously painful. Camels were continually getting left behind as we wound about among the dunes and little hills of rock. They found bits of grass and fell to grazing. It was very difficult to see them against the red sand spotted with patches of dark stone.

By May 14 we were anxious to reach Erdi as soon as possible, for water was becoming scarce and the camels weak and tired. Shortly after the afternoon start two of the men found the track of a big *warran* or desert lizard, and we followed it to its hole. We dug into the hole, but the lizard was not at home. We traced its track to a pile of rocks, and after twenty minutes of excavation caught it. The *warran* does not bite, but has a tail like a whip with which it can do damage. The Badawi and blacks use the fat of the *warran* as medicine for rheumatism, and believe that the head is a charm against black magic. At this stage of the day's journey the country changed into undulating ground with valleys full of green grass and dry *nisha*—one of the signs that we were approaching Erdi. It was not until the early morning of the 16th, however, that the red sandstone hills of Erdi leapt into view. There was some discussion as to whether we should camp on the hills above the valley in which the well lies or go down to it; we decided on the latter plan, since in case of attack by marauders we should at least have possession of the water-supply. After steadily climbing through rough defiles between cliffs of red rock we came out suddenly on the top of a cliff with the pleasant *wadi* of Erdi stretched out below us. It is a narrow valley, 8 kilometres long and not more than 100 metres wide, surrounded by sheer cliffs of red rock. Trees and green grass, after the monotonous *serira* and bare rocks, made it seem the traditional oasis in the desert. Sukkar and Herri went forward to reconnoitre: the blacks are always cautious when they come to a well, sending a man or two ahead to make sure that if any one is already there, he is not a stranger, or at least not an enemy. We picked our way laboriously down the rough path into the valley and pitched camp at its northern end. The well lies at the extreme south, and the only way of getting at it from above without great risk to the camels was the way we came.

The valley of Erdi is what is known as a *karkur*, a long narrow depression in the hills ending in a *cul-de-sac* where the well lies in a shadowy hollow under the rocks. The pool is semicircular in shape, 6 metres long, and half as broad. The well is like those at Owenat, although I

suspect that in addition to the rain-water it may possibly be fed by a spring. The valley is beautiful, with its sheer walls of red rock and the green grass and trees scattered about below them.

The guides warned me that from now on it would not be practicable to travel at night, the country being too hilly to be safely traversed in the darkness. We started at 5.30 a.m. on the 17th. As we reached the edge of the *wadi* and looked back I realized the difference between the valleys in these hills and those at Arkenu and Owenat. There the floor of a valley was on the same level as the plain outside; here the valleys were depressed below the general level of the country. Out of the *wadi* and turning to the south-east we entered a mountainous country of black and red rocks. Before camping we saw ahead of us the distant hills of Agah where the next well lay.

The valley of Agah, which we reached on the 20th, is very picturesque —a long narrow defile between high cliffs with more vegetation and trees than we had seen thus far. Halfway down its length it divides, one branch leading south-westward to the well, the other southwards towards the open desert. The well is similar to that at Erdi, but its water is badly fouled by sheep and camels. The valley is full of birds, whose pleasant songs recall the aviary at the Zoo. We also met inhabitants, Goran, from whom, after the customary ceremonies denoting that we came as friends, we tried to buy sheep. They refused to sell, but shortly afterwards returned with three sheep which they offered us as *diafa*, or hospitality, refusing to accept any money for them. They were delighted with *etkias* of blue cloth as a return courtesy.

We resumed our journey on May 21, while the stars were still shining in the clear sky. Winding our way down the eastern fork of the valley we sighted three gazelles. Three of the men gave chase, but the animals nimbly climbed the hills and escaped. Hamid the Zwayi fired and missed, to the scornful delight of the rest. He refused to admit complete failure. "By God," he maintained, "I hit it. I saw the blood spurt." Later, when the midday meal of roasted sheep was being prepared, one of the men cut his hand. Seeing blood, I asked where it came from. "From Hamid's gazelle!" answered Bukara, and there was renewed laughter over the unsuccessful hunter. After lunch, as I was winding my watches, recording the readings of the aneroid and the maximum and minimum thermometers, Hamid the camelman came running to say there was a herd of ostriches near by. We grasped our rifles and stood ready. Soon the ostriches appeared, thirty or forty in number, but the impatient Badawi opened fire while the distance was still too great, and the ostriches dashed off into another valley. Later Hamid, small and sharp of features and afraid of no animals, not even snakes, came upon an ostrich in a closed part of the valley, and after attacking it unsuccessfully with stones, rushed at it and caught it round the neck. He wrestled with it manfully, but it landed a kick on his side from one

of its powerful legs and ran away. Mounting a ridge, the ostrich looked back scornfully at Hamid, whose hand was pressed to his side. I asked whether the ostrich had hurt him, but he said, "No." "Why didn't you bring it back, then?" I inquired. He answered with great plausibility, "I had to let it go; she was only a female."

Starting at 5 p.m. we followed the lovely valley for an hour and then began to climb the hills. As we reached the top we had a fine view, all the various shades of green of the trees and shrubs making picturesque patterns with the rosy sand and the red rocks of the hills guarding the valley. The soft notes of innumerable doves floated up on the cool evening breeze. A gorgeous red and gold sunset completed an *ensemble* not easy to forget. We soon passed into a different country, broken and very undulating, with distant jagged hills surrounding us. The camels and men were suffering from the foul water of Agah, and, the country being dangerous to travel in by weak moonlight, we camped early.

We arrived at Enebah well on May 23. The water was excellent, and we all enjoyed the change. There was quite a large Bidiyat camp here, with hundreds of sheep and a few horses for the sheikhs. The whole population came out to greet us, and I shook hands with them, distributing scent and putting a little on the hand of each one. They brought us sheep as *diafa*, and the women, who have a keen business sense, produced butter and leather to sell to us. In the evening I took observations. The Bidiyat were frightened at the theodolite and the electric torch, and their suspicions were aroused. One of the sheikhs entered my tent and caught me opening the instrument case. I shut the case quickly and instantly realized my mistake. I could see in his cruel dark face with yellow eyes like those of a fox set close together that he believed I had gold in the box. As the sheikh left my tent I ostentatiously ordered two of my men to stand as sentries in the camp. Pointing to them I told the sheikh not to allow the women and children to approach the camp at night, lest my men might made a mistake and shoot at them. It was just a hint that we were wide awake and that there was no hope of catching us off our guard. I could see that the hint went home.

The valley of Enebah is floored with soft sand, dotted with shrubs both green and dry and with trees. On May 24 I was awakened by the hubbub of Bidiyat women bargaining with my men for empty tins. They offered in return a kind of dry shrub which they called tobacco, and milk. Encouraged by a cool south-east wind we started at 3.15 p.m., but the wind soon dropped, and we made slow progress in the heat. The night was cold. We started again at 5.15 in the morning, but made slow progress owing to difficult going and the uncertainty of the guide. A little after five in the afternoon we dropped into a big valley, whose name we discovered later to be Koni-Mena, running east and west and filled with fine trees. There was a Goran camp in the valley, and a cattle merchant

had just arrived from Fada in Wadai with sheep and cows on his way to El Fasher. Our guide paid him a visit and got all his news.

On May 26 we followed sheep and camel tracks and marched from one valley into another until we camped in one of the largest, which had many shady trees. It was named Kap-Terku. We started again in the late afternoon and found a well, 7 metres deep with good water, though it had an unpleasant odour, the roots of a near by tree having rotted in it. Herri, of Owenat, proved a bad guide. He predicted that we would reach Bao on the morning of May 27, but night fell and we were still not there. His sense of direction was faulty. Our water had given out, except for one last *girba* (sheepskin), and it was very hot. We went on until 7.45, when we reached rocky ground, dangerous for the camels even in the clear moonlight. We were on the edge of a large valley, which Herri declared to that be of Bao, but we could not believe him. Experience had taught that the last of the water-supply should never be used until the next well is in sight and has been tested to make sure that there is drinkable water in it. We went to bed supperless, since we could not cook without water. The descent into the valley was steep and dangerous, the camels throwing off their loads, which had to be carried by the men down to level ground and loaded again. At last we saw a few sheep and a straw hut or two, so I allowed the men to drink the water from the last *girba* for which they had so often asked that morning. Soon some blacks of the Goran and Bidiyat tribes came to meet us. There are several scores of them at Bao. The women are graceful creatures clothed with the utmost simplicity. Their dress is either a length of cloth wound skilfully around the body, with a narrow strip of cloth for a belt, in which is carried a small knife, or a sheepskin wrapped round the lower part of the body. Their hair is arranged in small plaits. They wear ornaments of silver and ivory, heavy rings in the hair, and bead and amber necklaces. Young girls wear only an apron of cloth or leather. The men have splendid physique, go practically naked, and carry two or three spears, a sword and throwing-knife. Only Sheikhs wear white robes and turbans. We gave the women and children macaroni, but they refused to eat it. Instead they threaded the pieces on strings and made necklaces which they wore proudly. The business instinct of the Badawi at once displayed itself. They made necklaces from our little store of macaroni and exchanged them for butter and leather.

We set out again at 1 a.m. on May 30. There was a strong and dusty south-east wind, which dropped in the evening. The country was flatter than before, with no large valleys and no big trees. We halted at 8.30 to camp for the day. There were tracks of lions about. On June 1 we reached Wadi Hawar, which runs in a semicircle from north-east to north-west. There is a thick growth of big trees and cultivable soil like that of Egypt. After leaving Wadi Hawar the country was more

CAMP AT ARKENU

THE VALLEY AT OWENAT

VALLEYS BETWEEN ERDI AND AGAH

SAND DUNES BETWEEN OWENAT AND ERDI

SAND DUNES BETWEEN OWENAT AND LAKE

ROCK CARVINGS AT OWENAT

ROCK CARVINGS AT OWENAT

GRANITE VALLEY AT OWENAT

undulating, with few trees, but covered with high dry grass. At 6.30 a.m. we passed a hill called Tamaira, on the top of which stands a dry tree marking the boundary between Wadai and the Sudan. We made a very early start on June 2 to make sure of reaching Furawiya that day. At 5 a.m. we passed the landmark of Hagar Kamra-ra, 10 kilometres away on our right, and an hour later Hagar Urdru, a hill about 80 metres high and 200 metres long. Hagar is the Sudanese word for *gara*, or small hill. Then we started dropping into the valley of Furawiya, the largest valley and the most inhabited that we had yet come across. Its inhabitants are Zaghawa and a few Bidiyat.

Contrary to my expectation, we found that no food was obtainable at Furawiya. We had had no sugar for three weeks, and had been obliged to sweeten our tea as best we could with pounded dates. Flour and rice had also given out, and a scanty diet of macaroni had become very monotonous. After some difficulty I found a messenger who consented to take a letter to Saville Pasha, the Governor of Darfur at El Fasher, asking him to send me provisions and clothes for my men, who were in rags.

We spent three full days at Furawiya, getting used to the damp climate we had come into and trying to get enough to eat to keep ourselves from feeling miserable. Every day it rained. My men gorged themselves with mutton, but the lack of sugar for tea and other provisions rather took the edge off their enjoyment of these feasts. On June 6 we started south in the afternoon and climbed slowly out of the valley, following a beaten track and passing frequently small villages of straw huts, women carrying *hatab*, and other signs of habitation. The next day we reached Um Buru, 38 kilometres from Furawiya. We camped near the well, and were awakened in the early morning by the sounds of cattle and sheep coming to water. An hour later a busy market was being held alongside our camp. We had unwittingly pitched our tents close by the big tree that marked the centre of the market-place. Only women took part in the market, bringing butter, leather, mats, maize, cotton, and salt, which they bartered with each other without the use of money. Meanwhile the men lay about at their ease and did nothing. As I watched such scenes in the Sudan I wondered sometimes whether the black women were not after all better off as slaves in a Badawi household. In the Sudan they do all the work that is done, caring for cattle and sheep, doing the housework, preparing meals, making the favourite beverage *merissa* for their men, carrying on the business of the market—everything. As slaves they would have only certain definite duties and some opportunity for leisure. Yet I seemed to catch something in the sound of their talk and their laughter that slaves do not generally have. Perhaps, after all, there is something in the feeling of liberty, even when it is accompanied by drudgery.

The next stage of our journey was a five days' trek to Kuttum,

129 kilometres to the southward, travelling early morning and late afternoon over a beaten track with fairly good going, through hilly country covered with dry grass and small trees. At intervals there were patches which had been burnt in preparation for being cultivated.

On the morning of the fourth day the men came rushing to me with the news that they had sighted a soldier on a camel. In a few minutes I had a letter from Mr. Charles Dupuis, Acting Governor of Darfur, in place of Savile Pasha, who had resigned from the service, and a small supply of rice, flour, tea, and sugar. I was especially pleased to have a supply of cigarettes. I had not smoked since soon after leaving Erdi. But it was when we camped at the Government rest-house at Marabig that general rejoicing broke loose with singing and dancing. The corporal, looking on while the men set the sugar-loaf on the ground and executed a wild dance about it, thought us all a little mad. Until one has tried going without any sugar whatever one does not realize how keenly it will be missed.

I decided to push on at once, since we should very soon be in need of more provisions. On June 14 we arrived at the outskirts of Kuttum. Soon a group of horsemen were seen approaching us, and my Badawi impulsively raised a cheer. When I recognized the uniform of Sudanese troops, it was the most cheering sight that I had seen for many weeks. There were two Moawins in command of a detachment of ten soldiers, the *Kadi* (Judge), the head clerk, and other officials and notables of Kuttum. I shook hands warmly with them all, and under their escort the caravan moved on through the village. As we approached the Markaz women clothed in white and beating drums greeted us with singing and "lu-lias." We settled ourselves in and about the rest-house, and the women came again to offer greetings. In a long line they sang and danced, much to the delight of my Badawi, who asked permission to "empty gunpowder" in acknowledgment of the courtesy. I could not refuse my consent, and one by one the men performed the ceremony of singeing the girls' slippers. The Sudanese women are not accustomed to the Badawi manner of paying homage as the girls of the northern desert, and flinched a little as the powder flashed at their feet. But they accepted it all in good part, the whole line swaying and dancing to the rhythm of the drums while one by one my men singled them out for the "slipper-singeing honour." It was a wonderful reception, and the pleasure of it dispersed like magic the fatigue and lassitude of the journey.

We stayed at Kuttum two days, entertained generously by the Moawins, in the absence of the Inspector, Mr. Arkell, who was at El Fasher. We left at 6 a.m. on June 17, and the two days' journey to El Fasher was a joy ride. We all felt the thrill of getting in touch with the world again. Three hours' march from El Fasher we camped to make preparations for entering the place. We shaved and put on our best clothes. Mr. Dupuis had sent a supply of white cloth to Kuttum for us, and my men were

able to appear once more in decent raiment. As we reached the outskirts of El Fasher, cheers of rejoicing rose throughout the caravan. A cavalcade of men in khaki was coming towards us. My horse pricked his ears forward and dashed towards them. Mr. Dupuis came forward on his horse to meet me, and we shook hands warmly. The greetings were repeated by the English and Egyptian officers of his staff, and we went on to his house, a part of which he generously made over to me and the men of my caravan. The officer in charge of the wireless station kindly got me the exact Greenwich time from Paris by radio. I was pleased to discover that my chronometer had only lost twenty-three minutes and twenty-three seconds in eight months, that is, less than six seconds a day. For ten days I was the guest of Mr. Dupuis and was lavishly entertained by the officers and officials of the garrison, both English and my own compatriots, and the notables of the town. One more camel trek lay before me to El Obeid. There I took train for Khartoum and thence home to Cairo, where I arrived on 1 August 1923.

I cannot close this record without expressing my deep appreciation of the hospitality shown me and the help accorded me by Sir Lee Stack Pasha, Sirdar and Governor-General of the Sudan, Mr. Dupuis, Acting Governor of Darfur, Mr. Craig, Governor of Kurdufan, and all officers and officials of the Sudan Administration.

Before the paper the PRESIDENT (the EARL OF RONALDSHAY) said : Our lecturer this evening, Hassanein Bey, has already distinguished himself in various walks of life. He is, as you all know, a rising member of the Egyptian Diplomatic Service. He is also an extremely successful fencer. In his younger days he represented the University of Oxford in that branch of military art, and he is very shortly about to represent his own country at the Olympic Games. But to us geographers his fame is even greater as a traveller. His first great journey took him, in company with a daring traveller of this country, Mrs. Rosita Forbes, into the very heart of the Libyan Desert. But not content with the outcome of that journey, important and valuable though it was, before long he made a second journey, and on this occasion he did not stop short at Kufra, the furthest point of his previous expedition ; he travelled on for a distance of some thousand miles in circumstances of great difficulty, of much hardship, and of no small peril, right through the southern stretches of the Libyan Desert until he emerged in the province of Darfur. Not only did he show in the course of that journey that he was an intrepid and a resourceful traveller, but he also showed that he was an excellent geographer, and the geographical results of the journey of which we are to hear to-night have received the highest commendation of the Egyptian Survey. He has also been fortunate in securing a large number of most admirable photographs, and you will, I am sure, follow with rapt attention the account which he will be able to give us to-night of this outstanding piece of exploration, illustrated by the fruit of his photographic skill. I now, with much pleasure, call upon Hassanein Bey to give us an account of his journey.

Hassanein Bey then read the paper printed above, and a discussion followed.

The PRESIDENT: We are fortunate in having present this evening the companion of Hassanein Bey's first journey, the intrepid traveller Mrs. Rosita Forbes. I will ask her if she would like to say a few words.

Mrs. ARTHUR MCGRATH (ROSITA FORBES): It has given me particular pleasure, naturally, to listen to Hassanein Bey's most interesting lecture, because it arouses so many fascinating memories of three years ago, especially memories of the feasts at Kufra. I always remember at one particular feast, when Hassanein Bey, I believe, was contemplating a speech to the Governor of Kufra, seizing him by the arm and saying firmly, "Don't bother about that. Tell me, how long do you think they will leave us alone with this food?" Another reason why I was delighted to listen to this lecture was because I think, possibly, the remarkable journey which Hassanein Bey has now so successfully concluded was first projected by him when we stood on the Kufra cliffs in 1921 and looked across to the opening on the other side of the valley. I remember Hassanein Bey then saying, "I would like to see where that goes to." And now he has not only seen for himself, but in his graphic description of a very gallant enterprise he has taken us all with him.

None of us, I think, who have any imagination, could have failed to grasp the difficulties and the hardships inevitable on such a tremendous journey. But a meed of appreciation is also due to the patient labour which must have been expended on the preparation of such a journey. I remember it took me a whole year's hard work to prepare the means and ways for our very much shorter journey in 1920. That Hassanein Bey succeeded in interesting his Government in such an expedition is testimony to the eloquence with which he so often facilitated my own way. Besides this, I think it must have taken as much energy and resource to prepare such an exploration as it took courage and endurance to carry it out. I am sure we would all like to congratulate Hassanein Bey, not only on his personal triumph, magnificent as it is, but on the fact that he has brought a new nation into the field of exploration. Perhaps hitherto France has held the palm for Saharan travel. And do you all know that it is actually a Frenchman, Mons. Bruneau de Laborie, who is the second European of our era to visit Kufra as he passed through the Kufra Valley on his magnificent journey last year from Nigeria to the Mediterranean? Egypt, by reason of her race, religion, and language, has unique opportunities for solving the last desert secrets, and now we hope that, inspired by Hassanein Bey's splendid exploit and taking advantage of his experience and initiative, she will open up the lost African trade routes and re-occupy the position that was so triumphantly hers up to the end of the fourteenth century of our era.

The PRESIDENT: The lecturer mentioned the fact that he sent out S.O.S. messages on one occasion to Savile Pasha. That gentleman happens to be present to-night. He was until recently Governor of Darfur, and I am sure you would like to hear him.

Lt.-Col. R. V. SAVILE: I have nothing to say that could possibly interest you, for the lecture to which we have listened has left nothing for me, except to express my great regret at not being in El Fasher to meet Hassanein Bey when he arrived. I had the misfortune to leave the province of Darfur, which I am sorry to say I am never going back to, about ten days before. It was really a great source of disappointment both to my wife, who was there with me, and to myself that we were not there to welcome Hassanein Bey.

Mr. E. G. SARSFIELD-HALL: I feel flattered that I have been asked to

ROCKY COUNTRY BETWEEN OWENAT AND ERDI

GRASS-COVERED DESERT SOUTH OF OWENAT

GRASS COUNTRY NEAR ERDI

ON THE WAY TO AGAH

address this distinguished audience, for I should be more correctly described as a bushwhacker than an orator. Perhaps, however, I have some little claim to distinction in having been one of the two men who have administered northern Darfur from a tiny little post called Kuttum. I have never seen Kuttum written so large on a map before as it was written on Hassanein Bey's map this evening, and I felt quite proud to see it.

Hassanein Bey made a most wonderful journey. The country which I administered began just north of Furawiya, which was almost, one might say, at the end of his difficulties. I am glad he did not come very much in contact with the Zaghawa, because they are rather an unpleasant and difficult people to deal with, and are such notorious thieves that they have the reputation of attempting to steal the beard and eyebrows off any traveller who passes through their country if they happen to come upon him when he is asleep. I am now stationed nearer civilization at El Obeid, which was the end of Hassanein Bey's journey, and I am extremely sorry that owing to the fact that I was on leave last year when he passed through El Obeid I was unable to be present at his welcome there. I have heard many nice things about him, not only from the people in northern Darfur who have met him and who still communicate with me from time to time, but also from the officials in the Sudan who had the pleasure of meeting him. I have never heard such golden opinions so universally expressed about anybody as the opinions which I have heard expressed about Hassanein Bey. Having myself travelled many hundreds of miles on camel-back in desert regions, I can appreciate the difficulties overcome by him and the great triumph which he achieved in making his wonderful journey from Sollum right through to El Obeid.

Mr. W. J. HARDING KING: I have no personal experience of any of the places visited by Hassanein Bey, but in 1910, I think it was, I tried to get from Dakhla to that place known as Owenat, but—well I did not succeed. He was asking about the rock inscriptions. There are a very large number of them to be found on the Gubari road that runs between Kharga oasis and Dakhla. I do not remember seeing any giraffes, but there are various horned beasts that are rather difficult to identify and a number of drawings of horses or donkeys, together with a large number of camels. I am wondering whether he can give us any explanation of the large amount of water that there is to be found in Kufra. It seems obvious that it cannot be due to local rainfall, and one rather expects that unusually large water-supply to come from the Tibesti Mountains. I should like to ask him whether he knows of any old watercourses to be found in the desert. Formerly I think there must have been a much heavier rainfall in that part than at present, and it is rather difficult to see where the rainfall from the northern side of the Tibesti Mountains eventually flowed. I have heard vague rumours of a large watercourse that runs up north through the Kufra group of oases, and should like to know whether Hassanein Bey can confirm that in any way. And may I compliment him most warmly on his journey and on his safe return from it?

The PRESIDENT: Before we adjourn and before I ask Hassanein Bey to say one or two words in reply, as I understand he desires to do, I would like to express to him on my own behalf and on your behalf, our great gratitude for the lecture which he has given to us this evening. He mentioned in the earlier part of his lecture what he described as "a nasty habit" on the part of some of the Senussi of disposing of their superfluous womenfolk. Unfortunately, it is not only the Senussi who occasionally are guilty of this nasty practice. It brought to my mind the custom of one of the aboriginal tribes

in India, the Kondhs of Ganjam, who also were accustomed to dispose of superfluous daughters, and in explaining to a complaining British officer the reason for this practice they told this story: They said tbat the Sun-god, dismayed at the deplorable results produced by the creation of feminine humanity, had instructed them in future to bring up only so many daughters as they could be sure of keeping out of mischief. At a later period of his lecture Hassanein Bey described the country through which he was travelling as an ideal man's country, and all these things, I think, bring home to us in a way which perhaps one hardly realized before, what an outstanding performance it was on the part of Hassanein Bey's companion, Mrs. Rosita Forbes, to carry through with him the earlier journey to Kufra.

Nothing will give me greater pleasure than on this day week to hand to Hassanein Bey, as I shall do, on behalf of this Society, the highest award to a traveller which this Society has within its power to give, the Society's Gold Medal. We congratulate our lecturer this evening not only upon the successful outcome of a very hard and perilous journey, but also upon the achievement of such excellent geographical results as have secured for him this recognition. I will now ask him, if he desires to do so, to say a word in reply to anything that has been said in the discussion.

AHMED HASSANEIN BEY: In reply to Mr. Harding King as to the water in Kufra, all I know about the subject is that certainly there is no rainfall of any amount at all in Kufra at present. I was there in late March and April. It rained twice during that time, and one could literally count the drops of rain that fell. The Badawi say that forty-five years ago Kufra was a grazing-ground, but they used to squabble and fight about the grazing there, so the first of the Senussi Ikhwan gave a curse: "May God stop the rain on Kufra, so that there will be no grazing-ground and therefore no fighting." And from that day, they say, there has been no rainfall. As it stands now Kufra, unfortunately, is a very difficult place in which to keep camels, and that is why no camels remain there for any length of time. They must go north or south; there is no grazing for them at Kufra. I have asked about the wells in the Oasis itself, and am informed that they have not decreased in any way. I have not heard of any watercourse north of Kufra. Certainly the Zieghen district, the wells north of Kufra, according to Rohls, was green forty-five years ago. As to the drawings on the rocks at Owenat, where we saw representations of the giraffe and the ostrich: I have seen the giraffe and the ostrich on my travels, and they certainly live in far more cultivated or green country than Owenat is at the present time. There is no doubt that a big climatic change is taking place in the whole of the Libyan Desert, and perhaps we shall find that within the last hundred or two hundred years its nature has totally changed.

I want to point out that this journey has been a success only owing to the great help, encouragement, and assistance of His Majesty King Fuad of Egypt. It was by his help and encouragement that I was enabled to obtain six months' leave from my duties, and afterwards that the Egyptian Treasury paid the expenses of the journey. I feel it is my duty to mention that at a meeting of this Society.

NOTE ON THE CARTOGRAPHICAL RESULTS OF HASSANEIN BEY'S JOURNEY

John Ball, O.B.E., D.Sc., Director of Desert Surveys, Egypt

1. **INTRODUCTION.**—The cartographical data brought back by Hassanein Bey consist of

(1) Note-books containing the records of astronomical observations for the determination of time, latitude, and compass-variation at nineteen principal camps, with records of watch-comparisons.

(2) A journal giving a continuous record of observed compass-bearings and estimated distances from Siwa Oasis to Lameina Wells, near El Fasher, a distance of about 2430 kilometres.

The journal also contains a considerable number of observed compass-bearings to conspicuous features on either side of the route, with a few rough trigonometrical estimations of the altitudes of mountains passed, a large number of readings of an aneroid barometer and sling thermometer for the estimation of altitudes along the route, daily observations of maximum and minimum temperatures, observations on the character of the country passed through, and notes on the meteorological conditions.

These observational data have been reduced in the Desert Survey Office, Cairo, and utilized in the preparation of the map on a scale of 1 : 2,000,000 which accompanies Hassanein Bey's account of his travels. The object of the present note is, first, to give an account of the critical examination to which the records were subjected in the course of the reduction of the observations, so as to enable an estimate to be formed of the degree of precision which may be fairly assigned to the geographical positions, altitudes, and other results used in the construction of the map; and, secondly, to indicate the additions to existing geographical knowledge concerning a little-known region of north-east Africa which have accrued from the expedition.

2. Astronomical Determination of Local Time.

Theodolite observations of altitudes of the sun or of stars were made at all the principal camps for determining the error on local mean time of the half-chronometer watch which was used in the latitude observations. In all, thirty-four complete time determinations were made at seventeen camps. The observations were made with a 3-inch Troughton & Simms theodolite, the vertical circle of which could be read by two verniers to 1′, and which was provided with a sensitive level on the microscope arm. The theodolite was invariably set up in the magnetic meridian by its trough compass, and the method used was to note the times of passage of the sun's limb or of the star over each of the three horizontal wires of the stadia-graticule, reading the level and circle at each pointing, face-right and face-left. In the case of stars, the magnetic bearing of the star was also noted from the horizontal circle, and a note made of the colour and brightness of the star, for the identification of the stars subsequently in the office, and thus to free the observer from the necessity of knowing the stars' names. The barometer and thermometer were carefully read at each observation for calculating the refraction.

No difficulty was experienced in subsequently identifying the stars. In only a single case was it found necessary to reject an observation, and this because the observer had accidentally sighted different stars on the two faces of the instrument. On many days two or more observations were taken at the same

place, and comparisons of the results at these places indicated that the observations are remarkably accurate for so small an instrument. In seven cases where the sun has been observed shortly before sunset and a star soon after sunset, for example, the maximum difference between the results given by the two observations is only seven seconds, while the average is under four seconds. It is thus apparent that the precision of the time observations is amply sufficient to ensure that no sensible error in the latitudes can be due to errors of the adopted local times.

As the only use made of the time observations in the preparation of the map has been in the determination of latitude, it would serve no useful purpose to give a list of the watch errors. But it may interest future geographers undertaking long desert journeys, to note some of Hassanein Bey's experiences in the transport of watches, and the hazard of relying on constancy of rate for long periods with even the best watch.

Of the six watches carried, only a single one remained in going order throughout the journey. The timekeeper which thus successfully resisted the vicissitudes of the seven months of desert travel was fortunately the one with which Hassanein Bey took all his observations, and was carried in his pocket during the entire journey; it was a large-sized half-chronometer "explorer's" watch of English manufacture, with a dust-proof cap to the winding mechanism. It had been awarded an "especially good" certificate at the National Physical Laboratory of England, and was consequently the most expensive of all the six watches taken on the journey. Even this watch failed to maintain a sufficiently constant rate to be of any service in the determination of longitudes, though it amply sufficed for the latitudes, even in two cases when reliance had to be placed on the constancy of its rate for one or two days owing to latitude alone being observed without corresponding observations for local time. Thus, for instance, the following were the average rates of the principal watch deduced from local time observations at places of previously known latitudes:—

RATE OF PRINCIPAL WATCH.

Solum to Siwa ...	Dec. 29—Jan. 13	...	15 days	losing 5·8 seconds.
Siwa to Jaghbub ...	Jan. 13—Jan. 20	...	7 ,,	,, 0·1 ,,
Jaghbub to Furawiya	Feb. 14—June 5	...	111 ,,	,, 7·7 ,,
Furawia to Um Buru	June 5—June 8	...	3 ,,	,, 6·6 ,,
Um Buru to El Fasher	June 8—June 26	...	18 ,,	,, 9·4 ,,
El Fasher to El Obeid	June 30—July 15	...	15 ,,	,, 9·4 ,,

The above table fails, however, to bring out fully the actual variations of the watch. So long as the other five watches remained in order, Hassanein Bey made frequent comparisons with his principal watch, and between March 21 and 23 there is strong evidence that the principal watch made an abnormal gain of about fifty seconds. A similar abnormal gain of twenty-nine seconds by the principal watch is evidenced in the twenty-four hours between comparisons of March 24 and 25. Both these abnormalities occurred between Jalo and El Harrash, at an early stage of the journey, while all the watches appeared to be behaving tolerably well, and it is quite possible that other abnormalities occurred at later stages, when, owing to some or all of the other watches having stopped or broken down, no satisfactory control by comparison was possible.

Of the other five watches carried, one was an English half-chronometer, similar to the principal watch but of smaller size; three were high-class Swiss

lever ("Peerless") watches with very tight-fitting cases; and the fifth was a small Swiss lever watch with luminous dial, carried on the wrist for noting the times of marching. The small half-chronometer stopped on April 3, after going for over four months; and though it was re-started, its rate changed considerably after the stoppage. The three "Peerless" watches, though they failed to continue going to the end of the journey, showed by no means a bad record. One was found stopping and unreliable on May 6, after going for over five months; the two others continued to go for over a month longer; and so far as can be judged from the comparisons made on the route, their variations of rate were about of the same order as those of the half-chronometers. The wrist-watch, from the manner in which it was carried, was of course liable to much greater variations of rate, and was occasionally reset by the principal watch; but it kept going till nearly the end of the journey.

As regards dust-resisting power, which must always be one of the principal aims in selection of watches for desert exploration, there appears to be nothing to choose between good English half-chronometers and the highest class of Swiss watches, the cases of the latter being remarkably close-fitting. The most probable cause either of stoppage or of abnormal changes of rate appears to be the sudden shocks which may arise either to a watch carried on the person when jumping on or off a camel, or to one carried in the baggage by sudden movements of the camel. The most likely explanation of the abnormal gains of the principal watch for short periods on the two occasions above noted would seem to be that owing to a jerk in mounting or dismounting, two contiguous coils of the hair-spring may have been made to touch each other for a short time, with consequent temporary shortening of the period of vibration of the balance-wheel. It is noteworthy that the watch which remained going throughout the journey was the largest of all those taken, and its greater resisting-power may have been to some extent due to its size permitting of greater strength in its component parts.

3. Astronomical Determinations of Latitude.

Observations for latitude by altitudes of the Pole-star were carried out on thirty-five nights at nineteen principal camps, using the same 3-inch theodolite as was employed for the time-observations. Three readings of altitude were made on each face, using each of the three horizontal stadia-wires in turn, the corresponding times being noted on a half-chronometer watch whose error on local time was accurately known from sun or star-observations carried out just before the latitude-observation. Particular care was taken with the level-adjustment, and the air-pressure and temperature at the time of the observation were recorded.

The following table gives the results of the observations:

ASTRONOMICAL LATITUDES.

										°	′	″
Sollum ...	...	...	...	4	nights	...	...	Lat.	31	35	9	N.
Siwa ...	...	...	...	1	,,	...	...	,,	29	12	41	,,
Jaghbub	...	...	...	5	,,	...	...	,,	29	44	26	,,
Camp near Jalo		...	...	1	,,	...	...	,,	29	11	56	,,
Jalo (El Erg)	...	...	...	1	,,	...	...	,,	29	2	33	,,
Buttafal	...	...	...	1	,,	...	...	,,	28	54	26	,,
El Harrash	...	...	...	1	,,	...	...	,,	25	26	29	,,
Taj ...	...	...	...	6	,,	...	...	,,	24	13	47	,,
Arkenu...	...	...	...	2	,,	...	...	,,	22	12	32	,,
Owenat...	...	...	...	1	,,	...	...	,,	21	52	29	,,

										°	′	″	
Erdi	...	...	...	...	1	nights	...	...	Lat.	18	35	39	N.
Agah	...	...	...	..	1	,,	...	...	,,	17	52	38	,,
Enebah	...	...	...	...	1	,,	...	...	,,	17	21	24	,,
Bao	...	...	...	...	1	,,	...	...	,,	16	28	24	,,
Furawiya		...	...	...	2	,,	...	...	,,	15	21	51	,,
Um Buru		...	...	...	2	,,	...		,,	15	3	57	,,
Kuttum	...	...	...	...	1	,,	...	...	,,	14	12	15	,,
El Fasher		...	...	...	2	,,	...	...	,,	13	38	3	,,
El Obeid		...	...	...	1	,,	...	...	,,	13	10	51	,,

Of six of the above places (Sollum, Siwa, Jaghbub, Kuttum, El Fasher, and El Obeid) the latitudes are accurately known from the Egyptian and Sudan official surveys, and the agreement in these cases is very satisfactory, though a very close comparison is not generally possible owing to uncertainty as to Hassanein Bey's precise observation-spot. At Jaghbub, Hassanein Bey records that his observation-spot was 200 metres S.S.W. of the dome of the mosque. Applying the corresponding difference of latitude (– 6″) to my own determination of the latitude of the dome in 1917 (29° 44′ 41″) we obtain 25° 44′ 35″, showing a difference of only 9″ from Hassanein Bey's observed latitude.

A further test of the degree of precision of the latitude-observations can be made by comparison of the latitudes found for the same camp by observations taken on different nights. The following gives the average deviation of a single observed latitude from the mean at all the camps where two or more observations for latitude were made:

										″
Sollum	...	...	...	4	nights	...	...	Av. dev.	8
Jaghbub		...	...	...	5	,,	...	...	,,	40
Taj	...	...	...	...	6	,,	...	...	,,	12
Arkenu	...	...	...	...	2	,,	...	...	,,	6
Furawiya		...	...	...	2	,,	...	...	,,	8
Um Buru		...	...	...	2	,,	...	...	,,	23
El Fasher		...	...	...	2	,,	...	...	,,	6

It thus appears unlikely that any observed latitude can be as much as 1′ in error, and consequently in the preparation of the map, Hassanein Bey's observed latitudes have been accepted as fundamental data for all the places for which no previous determinations are known to exist, viz. El Harrash, Taj, Arkenu, Owenat, Erdi, Agah, Enebah, and Bao. His latitudes for Jalo (El Erg), Bir Buttafal, and Furawiya have also been adopted for the map, the first because it is possibly better than that of Rohlfs, with whose mapped position it is however in very close agreement; the second because while differing by about 2′ from Rohlfs' value (28° 36′ 22″) it is doubtless more exact, because it checks admirably well with Hassanein Bey's dead reckoning; and the third because, although the position of Furawiya is shown on the Sudan maps, it is outside the present limits of the Sudan triangulation and is possibly liable to some slight error.*

* Since the above was written, I have received information from the Director of Sudan Surveys that a recent extension of the Sudan triangulation-net includes Gebel Furawiya as one of the points, and that the precise position found for the summit of the hill is lat. 15° 20′ 59″·9 N., long. 23° 36′ 48″·1 E., altitude 954 metres above sea-level. This position differs by about 2 kms. from that shown on the map above referred to; but in view of the fact that the distance and bearing of Hassanein Bey's camp from the hill is unknown, though his observed latitude shows his camp to have

4. Observations of Compass-variations.

For finding the Pole-star easily when the sky was not very dark or was partially obscured by clouds, and also for obtaining the approximate bearings of time-stars for their subsequent identification, the theodolite was invariably set up in the magnetic meridian by its trough-compass, and the magnetic bearing of the pole-star was read on the horizontal circle after each latitude-observation and the time noted. In this way the approximate compass-variation was determined at each camp, with the following results:—

VARIATION OF THE COMPASS.

				° ′
Sollum	Dec. 1922 ...	... 3 obs.	...	2 34 W.
Siwa	Jan. 1923 ...	... 1 ,,	...	2 42 ,,
Jaghbub	Feb. 1923 ...	... 5 ,,	...	2 25 ,,
Near Jalo	March 1923	... 1 ,,	...	4 12 ,,
Jalo (El Erg) ...	,, ,,	... 1 ,,	...	4 5 ,,
Buttafal	,, ,,	... 1 ,,	...	—
El Harrash... ...	,, ,,	... 1 ,,	...	3 48 ,,
Taj	April 1923 ...	... 6 ,,	...	3 32 ,,
Arkenu	,, ,, ...	... 2 ,,	...	3 25 ,,
Owenat	,, ,, ...	... 1 ,,	...	3 32 ,,
Erdi	May 1923 ...	... 1 ,,	...	3 57 ,,
Agah	,, ,, ...	... 1 ,,	...	4 0 ,,
Enebah	,, ,, ...	... 1 ,,	...	4 21 ,,
Bao	,, ,, ...	... 1 ,,	...	4 59 ,,
Furawiya	June 1923 ...	... 2 ,,	...	4 32 ,,
Um Buru	,, ,, ...	... 2 ,,	...	3 25 ,,
Kuttum	,, ,, ...	... 1 ,,	...	4 26 ,,
El Fasher	,, ,, ...	... 2 ,,	...	2 51 ,,

The method of estimating the compass-variation with the theodolite is, of course, only rough; but the values found are probably correct at most places within half a degree, and they serve to show that there is no likelihood of any serious errors of dead-reckoning owing to local irregularities of the compass-variation. They have accordingly been utilized in reduction of the compass-bearings of the traverse to true bearings over the major portion of the route, where no previous determinations exist, and where in consequence the distribution of the isogonic lines is not known with any exactitude.

5. Longitudes.

The probability of some watches breaking in the course of seven months' travel had been foreseen, and from the outset it appeared improbable that any use could be made of the watches in the direct determination of longitude on so long and difficult a journey. We had decided accordingly to depend ultimately on dead-reckoning for longitude, making every effort to obtain an unbroken chain of compass-bearings and estimated distances between Jaghbub and some known place in the Sudan, the bearings to be taken with a good

been on a parallel about a kilometre and a half north of the hill, I have not thought it worth while to make any change in the adjustment of Hassanein Bey's data. The longitude adopted for the camp (p. 373) may be slightly in error, but it is unlikely that the error can exceed a mile or so. The difference of level between the top of the hill and Hassanein Bey's camp being unknown, the triangulation-level affords no control over Hassanein Bey's barometric value for the latter place, and consequently I have judged it best to use El Fasher as the south control point in adjusting the level-determinations.

compass with all possible precision, at very frequent intervals, and the estimates of distance to be carefully made each day from the marching time of the baggage-camels, assuming a normal rate of 4 kms. per hour over average desert, and making allowance for the variations in speed over ground of varying character. The journey being predominantly north to south, the estimates of distance could mostly be well controlled by the latitudes, while errors of bearing would not be cumulative, and would tend to cancel out over any considerable stretch of route. The primary reason for taking six watches was therefore not to determine longitude, for which at best they could afford only somewhat uncertain values, but to make sure of at least one watch being available throughout the journey for latitude-observations, without which no proper control of the all-important distances could be obtained.

The doubts about the possibility of safely transporting the watches proved justified, for all but one broke down before the end of the journey. But fortunately on the one hand the watch which survived sufficed amply for the determination of latitude (though its rate was insufficiently constant for it to be used uncontrolled in finding longitudes), and on the other hand the programme of a continuous chain of very careful bearings and estimation of distances was scrupulously adhered to from the departure of the caravan from Jaghbub, the last known place in Egypt, to Furawiya, the first known place in the Sudan—a journey of 2430 kilometres—and from this chain of bearings and estimated distances, combined with the observed latitudes, it was possible to estimate the longitudes of all places on the route with a fairly high probability of accuracy.

For the estimation of the longitude of Jalo (El Erg), a slightly different procedure was followed from that adopted for the other principal camps on the route. It will be noticed from the map that the general direction of the march from Jaghbub to Jalo was predominantly from east to west, instead of from north to south as in the rest of the journey. Consequently the observed latitudes do not afford so good a means of correcting the estimated distances in this stretch as elsewhere. But fortunately the observed latitude at Jalo does enable us to correct the previous estimation by Hassanein Bey (in 1920) of the distance of that place from Jedabia, and this combined with the then observed bearings would lead to one value for the longitude for Jalo, while if we can assume the accuracy of the estimated distances from Jaghbub to Jalo, we may use the observed latitude of the latter place to correct the bearings and thus arrive at another value for its longitude.

From careful consideration of all the available data, the two methods appear likely to be about equal in degree of approximation. The position at present accepted for Jedabia (lat. 30° 48′ 10″ N., long. 20° 13′ 30″ E.) open to a little uncertainty,* and the bearings taken by Hassanein Bey on his former expedition are probably a little less accurate than those of the present one. On the other hand, the estimations of the distances from Jaghbub to Jalo, as gauged by the latitude-control of the other portions of the route of the present expedition, are remarkably close to the truth, while a uniform correction to his bearings of less than half a degree would swing his dead-reckoning position for Jalo on to its observed parallel of latitude.

For the longitude of Jalo on the map I have therefore taken the mean of

* No observations are known to have been taken at Jedabia. The position given is that which I adopted for it in preparing a former map in 1921, and was arrived at by estimation from a car-and-compass traverse carried out by Captain Williams from Zuetina in 1918.

THE VALLEY OF ERDI

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the two longitudes found (1) by assuming Hassanein Bey's bearings correct from Jedabia and correcting his distances by the latitudes, and (2) by assuming his distances from Jaghbub correct and using the observed latitudes to correct his bearings. The results are :

	°	′	″
(1) From Jedabia, long. of Jalo (El Erg)	21	29	48
(2) From Jaghbub ,, ,, ,, ...	21	26	19
Adopted mean	21	28	3

It may be remarked in passing that the result places Jalo almost precisely where it is shown on Rohlfs' map of 1880.

As regards the longitudes adopted for the other principal camps along the route, the procedure has been as follows. The route was divided into the following nine sections between principal camps where latitudes had been observed : Jalo—El Harrash—Taj—Arkenu—Owenat—Erdi—Agah—Enebah—Bao—Furawiya, and the compass-traverse for each section was plotted on a scale of 1/500,000 from the recorded bearings and estimated distances. A true meridian was then drawn on each section from the mean of the observed compass-variations at its two ends, and the total difference of latitude of each section was scaled off and compared with the difference of latitude given by the latitude-observations. This comparison gave, of course, the average error of estimation of distance along each section, assuming the bearings correct. The results of the comparison for the various sections are tabulated below :

CORRECTION TO ESTIMATED DISTANCES.

Section of traverse.	*Plotted difference of latitude.*	*True difference from latitude-observations.*	*True-plotted diff. lat.*	*Correction to estimated distances.*
	km.	km.	km.	%
Jalo-El Harrash	375·0	399·0	+ 24·0	+ 6·4
El Harrash–Taj	131·5	134·2	+ 2·7	+ 2·1
Taj–Arkenu	217·7	223·7	+ 6·0	+ 2·8
Arkenu–Owenat	36·0	37·0	+ 1·0	+ 2·8
Owenat–Erdi	369·0	363·2	− 5·8	− 1·6
Erdi–Agah	75·6	79·2	+ 3·6	+ 4·8
Agah–Enebah	57·0	57·5	+ 0·5	+ 0·9
Enebah–Bao	99·0	97·7	− 1·3	− 1·3
Bao–Furawiya	124·2	122·7	− 1·5	− 1·2
Mean error of estimation of distances, per cent.				2·6

The average error of distance-estimation in each section of the route having been thus found, the next step was to scale off the various departures from the plotted traverses, correcting for the errors of distance-estimation, and then to convert the departures into differences of longitude. When this was done, the resulting total difference of longitude between Jaghbub and Furawiya was 2° 25′ 55″. But assuming the true longitude of Jalo to be that found above, and the true longitude of Furawiya to be as shown on sheet 53 D of the 1/250,000 Sudan survey map of 1921,* we have—

	°	′	″
Longitude of Jalo	21	38	3
Longitude of Furawiya	23	38	10
Difference	2	0	7

so that the difference of longitude found by the dead-reckoning requires

* See footnote, p. 370.

correction by 15′ 48″. This correction, which implies an average error in the observed compass-bearings of less than a degree, and a negligible correction to the adjusted distances, was distributed along the entire traverse in proportion to the difference of latitude between the principal camps, leading to the finally adopted longitudes shown in the following table :

CONCLUDED LONGITUDES.

	Dead-reckoning corrected by the latitudes.	*Further correction.*	*Concluded longitude.*
	° ′ ″	′ ″	° ′ ′
Jalo	—	—	21 28 3 E.
El Harrash	22 15 5 E.	... 4 10 ...	22 10 55 ,,
Taj	23 29 5 ,,	... 5 34 ...	23 23 41 ,,
Arkenu	24 52 10 ,,	... 7 55 ...	24 44 15 ,,
Owenat	25 2 34 ,,	... 8 18 ...	24 54 16 ,,
Erdi	23 22 34 ,,	... 12 5 ...	23 10 29 ,,
Agah	23 28 49 ,,	... 12 54 ...	23 15 55 ,,
Enebah	23 27 58 ,,	... 13 30 ...	23 14 28 ,,
Bao	23 16 18 ,,	... 14 31 ...	23 1 47 ,,
Furawiya	23 53 58 ,,	... 15 48 ...	23 38 10 ,,

In attempting to estimate the probable degree of accuracy of the concluded longitudes, we are faced with the difficulty that while we may be certain that the *average* error of the compass-bearings was less than 1°, which average error has been allowed for in the adjustment, we have no proof that in some of the individual sections the errors may not have been considerably greater. But in view of the great number of the observed compass-bearings (339) which make up the directional data of the 1754 kilometres of traverse from Jalo to Furawiya (an average of 38 observed bearings for each of the nine sections), and bearing in mind also the remarkable accuracy of the estimations of distance as evidenced by the latitude-observations, it would seem unlikely that any of the above-adopted longitudes for the principal camps can be in error by more than 3 or 4 miles. This implies a degree of accuracy which it would have been difficult to ensure by transport of even a considerable number of chronometers over a land journey lasting more than three months. It may, I think, be concluded that no better values for the longitudes can be obtained without the aid of wireless time-signals.

6. Altitudes above Sea-level.

For the barometric estimations of altitudes above sea-level, a 2-inch aneroid by Steward was used. This instrument, which was one of two specially made for the expedition, was very carefully compensated for temperature, and provided with a fairly open pressure-scale, a millimetre of pressure being represented by very nearly a millimetre of actual scale-length, so that estimations to half-millimetres of pressure could be readily made.

The aneroid was read morning and evening at each camp, and at numerous other points on the route, the air-temperatures being as a rule recorded at the same time, as given by sling-thermometer. The aneroid behaved very satisfactorily throughout the journey. There had, unfortunately, been no opportunity of testing the instrument before Hassanein Bey's departure, but it was in perfect order on his return, and was then tested in the laboratory of the Physical Department at Cairo, when it was found to require the following corrections (at about 25° C.) :—

Pressure, mm. ...	760	750	740	730	720	710	700	690	680	670	660	650
Correction, mm. ...	−2·3	−2·3	−2·3	−2·1	−1·4	−1·1	−0·1	+0·6	+1·7	+2·0	+2·8	+2·9

That the above corrections had remained sensibly constant throughout the journey is rendered extremely probable by the close agreement noted further on (p. 378) between the levels found for Jalo directly from the aneroid readings (corrected, of course, on the assumption of constancy of the table) and those found indirectly from readings of the mercurial barometer in the meteorological station at Siwa.

The first step in the calculation of the barometric levels was to collect the whole of the readings of the barometer and sling-thermometer at each of the nine principal camps, where a halt of at least several days had been made, and a considerable number of readings taken. The means of all the recorded pressures and air-temperatures were taken for each of these principal camps, and the pressure corrected for instrumental error from the table above given. The readings being taken at various times of the day, the diurnal variation of pressure could safely be neglected, as it would most probably disappear on taking the mean of the readings. To allow for the annual variation, the mean pressures were next reduced to the mean of the year by applying a correction based on the mean of the normal annual variations at Siwa and El Obeid, as found from the recent volume of 'Climatological Normals' issued by the Physical Department of Egypt and shown in the following table:

CORRECTIONS TO REDUCE MONTHLY MEAN PRESSURES TO ANNUAL MEANS.

	Jan.	*Feb.*	*March.*	*April.*	*May.*	*June.*	*July.*
	mm.	mm.	mm.	mm.	mm.	mm.	mm.
Siwa ...	− 3·4	− 2·0	− 1·9	+ 0·9	+ 0·9	+ 2·7	+ 3·5
El Obeid ...	− 1·2	− 0·7	+ 0·3	+ 1·2	+ 1·0	+ 0·6	0·0
Mean ...	− 2·3	− 1·4	− 0·8	+ 1·0	+ 1·0	+ 1·6	+ 1·8

A further correction to allow for the distribution of the sea-level isobars over the region traversed was desirable, but no sufficient data exist for estimating its amount; the distribution is however probably nearly linear, and such a distribution was approximately allowed for by assuming the previously accepted levels at Siwa (− 17 m.) and El Fasher (793 m.) to be correct and distributing any residual difference found by the otherwise corrected barometer readings between these two places uniformly among the different sections.

The difference of height corresponding to each difference of mean corrected barometer-readings was calculated by the tables of *Barometrische Höhenstufen* in Jordan's 'Mathematische und Geodätische Hülfstafeln,' for the air-temperature corresponding to the mean of the thermometer-readings at the two ends of the line.

The adopted levels of thirteen principal camps as found in the above manner are tabulated below. It is interesting to note that the residual difference of height which had to be distributed between Siwa and El Fasher, and which is presumably mainly due to systematic pressure-gradient, was 63 metres, corresponding to a normal fall of sea-level pressure between the two places of about 5 mm., and this is from other considerations probably very near the truth; also that the resulting adjustment which had to be made in the levels in any single main section of the route did not exceed 5 metres.

CONCLUDED ALTITUDES ABOVE SEA.

	Number of observations.	*Mean pressure (corrected).* mm.	*Mean temperature.* ° C.	*Diff. of height from Jordan's tables.* metres.	*Diff. of height (adjusted).* metres.	*Altitude sea-level, above* metres.
Siwa	4	762·6	12	—	—	− 17
Jaghbub	50	757·7	15	+ 54	+ 49	+ 32
Jalo	18	754·7	17	+ 34	+ 29	61
El Harrash	6	732·8	23	+ 254	+ 249	310
Taj	31	718·5	19	+ 170	+ 165	475
Arkenu	12	708·0	31	+ 128	+ 123	598
Owenat	14	706·3	31	+ 21	+ 18	616
Erdi	7	683·3	31	+ 295	+ 290	906
Agah	3	695·2	34	− 157	− 162	744
Bao	5	677·7	33	+ 230	+ 225	969
Furawiya	11	685·8	31	− 107	− 112	857
Um Buru	8	679·5	30	+ 83	+ 78	935
Kuttum	5	660·2	24	+ 254	+ 249	1184
El Fasher	5	689·7	31	− 386	− 391	793

After thus determining the levels for the principal camps, those of intermediate camps and other places were computed in a similar manner, adjusting each section to the adopted levels at its terminal points. The maximum adjustment which it was found necessary to apply to the difference of height given by the barometer between points a day's journey apart was 5 metres, and the average 3 metres.

An exception was made in the stretch between Jaghbub and Jalo, where no intermediate levels were adopted for the map, owing to the extremely unstable state of the atmosphere during the journey between these two places; sandstorms of great violence occurred on several days of marching, with such rapid fluctuations of air-pressure that no heights could safely be deduced from the barometer-readings.

As regards the degree of reliability of the deduced levels, some little uncertainty exists in the levels adopted for the terminal points Siwa and El Fasher, while the temperature-compensation of the aneroid has not been tested and may not be quite perfect. Taking everything into account, it may be estimated that the levels of the principal camps are probably correct to within about 20 metres, while those of the intermediate camps and other points, for which only one or two readings of the barometer are available, may possibly be in error by twice that amount.

7. Summary of Principal Geographical Positions and Levels.

	Latitude N. ° ′ ″	*Longitude E.* ° ′ ″	*Metres above sea.*	*Remarks.*
Jaghbub (mosque)	29 44 41	24 31 11	32	Position from previous determination by Dr. Ball.
Jalo (El Erg)	29 2 33	21 28 3	61	
Bir Buttafal	28 54 26	21 45 15	98	
El Harrash well (Zieghen) ...	25 26 29	22 10 55	310	
Taj (Kufra)	24 13 47	23 23 41	475	
Boema (Kufra. Rohlfs' camp)	24 13 8	23 24 40	400	Short compass traverse from Taj.

	Latitude N.	*Longitude E.*	*Metres above sea.*	*Remarks.*
	° ′ ″	° ′ ″		
Arkenu	22 12 32	24 44 15	598	
Owenat	21 52 29	24 54 16	616	
Erdi (Camp 8 kms. north of well)	18 35 39	23 10 29	906	
Agah	17 52 38	23 15 55	744	
Enebah	17 21 24	23 14 28	1100	
Bao	16 28 24	23 1 47	969	
Furawiya	15 21 51	23 38 10	857	Longitude from Sudan map.

8. Construction of the Route Map on Scale 1/Two Million.

In the process of utilizing the dead-reckoning for the determination of the longitudes of the principal camps, the whole route had been provisionally plotted on to a scale of 1/500,000 direct from the field-books, on a series of sheets each comprising one section of the route. To these plottings of the actual route were now added the computed levels of all camps, the geographical features fixed by cross-bearings on either side of the route, and notes on the nature of the ground. The various sections thus provisionally mapped on 1/500,000 were then reduced to the scale of 1/2,000,000, allowance being made for the small departures of the original plottings from the 1/500,000 scale as found by the latitude-observations, and the various sections so reduced were drawn in on the final map between the finally adopted positions of the principal camps. It was found practicable to show all the principal geographical features on the final scale, though many notes on the nature of the ground had perforce to be omitted in order not to overcrowd the map. These notes are however carefully preserved on the 1/500,000 manuscript sectional maps in the Desert Survey Office in Cairo, so as to be available for future reference, while the principal of them are incorporated in Hassanein Bey's narrative of the expedition.

The main portion of the route, namely that from Jaghbub to Furawiya, has been mapped entirely from Hassanein Bey's journals and note-books. The portions of his route from Sollum to Jaghbub in the north, and from Furawiya to El Obeid in the south, have been copied from the latest official survey maps of Egypt and the Sudan, as being more accurate than any route survey could be.

The fixing of the positions of El Harrash and Taj by Hassanein Bey's observations has enabled the course of his former expedition to Kufra (with Mrs. Forbes) in 1920–21 to be delineated more accurately than was possible from the original records of that journey, which were unaccompanied by any astronomical observations; and the course of the former route, adjusted to newly determined positions, has been indicated on the new map by a dotted line.

9. Additions to Geographical Knowledge resulting from the Expedition.

Jalo.—The first portion of Hassanein Bey's route from Jaghbub to Jalo appears to be identical with that trodden by Rohlfs in 1869. At Gara Matan Sidi, about halfway between Jaghbub and Jalo, the track forks, and Hassanein Bey went by the northern (Zawaiya) branch, which passes Hiseila Wells and enters Jalo from a more northerly direction than the southern (Majabra) branch taken by Rohlfs.

Hassanein Bey's position for Jalo is almost identical with that of Rohlfs, but peculiar interest attaches to the former's determination of its level at

61 metres above sea. Rohlfs, visiting the place in 1869 and 1879, had found the aneroid to indicate a level below the sea in 1869, and above it in 1879, and had ultimately concluded that both Aujila and Jalo lay about at sea-level.* Hassanein Bey's determination is based on ten days' aneroid readings and comparison with Siwa, and it is noteworthy that exactly the same altitude (61 metres) for Jalo results whether the comparison is made with the readings of the standard barometer in the meteorological station at Siwa during the same period, or with the readings taken by Hassanein Bey with the same aneroid on four days at Siwa two months earlier (allowance being made, of course, for the annual variation of pressure over the intervening period). There can, I think, be hardly any doubt of the greater accuracy of Hassanein Bey's determination, since it is unlikely that Rohlfs' readings extended over so long a period, and it is practically certain that no comparisons were made by him with simultaneous observations at a place of known level. It should however be mentioned that Hassanein Bey's level probably refers to a somewhat higher observation point than that of Rohlfs; for owing to sand-drifts enveloping the houses, the inhabitants of El Erg are gradually rebuilding their dwellings on higher ground, and his observations were taken in one of the most recently constructed of these. Another point worthy of remark is, that although Hassanein Bey's determination is to a certain extent checked by the exact agreement of the two methods of comparison above referred to, the day-to-day variations of pressure observed at Jalo are much in excess of those at Siwa during the same ten-day period. The extreme range shown by the aneroid at Jalo was 10 mm. against 5 mm. of the standard barometer at Siwa, and the 7 mm. average difference of pressure between the two places for the ten days of comparison which has been used to calculate the new value of the level, is the mean of difference ranging from 1 to 12 mm. on different days. The relatively great variability of atmospheric pressure at Jalo, which readily explains the discordant results noted by Rohlfs on different dates, may be closely connected with the sandstorms which are so frequent in the neighbourhood.

Bir Buttafal.—Bir Buttafal ("Battifal" of Rohlfs) is of importance as being the last watering-place for caravans proceeding on the weary desert march of nearly 400 kms. to Zieghen. The position found for Bir Buttafal by Hassanein Bey agrees fairly well with that given by Rohlfs:†

	Lat. N.			*Long. E.*			*Metres above sea.*
	°	′	″	°	′	″	
Bir Buttafal, Hassanein Bey	28	54	26	21	45	15	98
,, ,, Rohlfs	28	56	22	21	44	10	58
Difference		1	56		1	5	40

Zieghen ("Sirhen" of Rohlfs).—Zieghen is the name of a district containing numerous wells. It is not inhabited, but is of great importance as lying on the main caravan route from Jalo to Kufra. The principal well used by the caravans is El Harrash. Rohlfs did not visit Zieghen; he travelled from Jalo to Kufra by the more westerly track through Taiserbo and Buseima, and the position shown for Zieghen on his map, which was based merely on his guides' statements, is about 100 kms. too far to the east-north-east.

As the journey from Jalo to Kufra by any future traveller is likely to be undertaken in the winter, when the question of fuel is second only to that of

* Rohlfs, 'Kufra,' 1881, p. 226.

† *Mitt. Afrik. Ges.*, Band ii., 1880–1881, p. 17.

water, it is worth noting that the first "hatah" (firewood) is met with at about 342 kms. after leaving Bir Buttafal, and 52 before reaching El Harrash well. In an emergency water may be got at Matan Abu Hosh, the old well of Zieghen, about 18 kms. before reaching El Harrash; but El Harrash yields better water, and being the regular halting-place of the caravans, the water can usually be obtained there without digging; hence, unless the caravans are very thirsty they usually prefer to go on to El Harrash rather than make a halt at the old well. Excellent water can be got anywhere in the neighbourhood of El Harrash by digging to a depth of 3 or 4 feet. From El Harrash to Buseima is about 54 kms. in a direction a little west of south, and from El Harrash to Taj, the principal town of Kufra proper, is 182 kms. in a south-westerly direction.

Taiserbo.—Taiserbo, the most north-westerly oasis of the Kufra group, has not, so far as is known, been visited by any traveller since Rohlfs' day. Its position was however indicated to Hassanein Bey as lying between 70° and 80° west of north from El Harrash, at a distance of 60 to 70 kms. This indication would place Taiserbo very nearly in the position which Rohlfs assigned to it. Rohlfs' position for his camp at Kasr Djrangedi is probably therefore substantially correct, though it is likely that the oasis is in reality less extensive than shown on his map.

Buseima.—Although Buseima was not visited by Hassanein Bey on this occasion, his fixation of the position of El Harrash, in combination with his former rough compass-traverse from that place to Buseima with Mrs. Forbes in 1921, permits of a fair approximation for its position. Hassanein Bey's estimates of distances and bearings on his former journey (adjusted by his recently observed latitudes at El Harrash and Taj) give his camp in Buseima as being 60 kms. from El Harrash in a direction of 5° east of true south, and from his camp to that of Rohlfs (Ain el Nusrani) was roughly about 15 kms. in a true west-north-westerly direction. Adopting Hassanein Bey's recently fixed position for El Harrash, this would give a position for Rohlfs' camp about 30 kms. south-west by south of where Rohlfs placed it, as is shown by the following comparison:—

	Lat. N.			*Long. E.*		
	°	′	″	°	′	″
Buseima (Rohlfs' camp) from Stecker's observations ...	25	11	42	22	15	0
" " " Hassanein Bey's estimation	24	38	11	22	5	46
Difference		13	31		9	14

It would hardly seem possible that Hassanein Bey can have made so large an error as 25 kms. in his former estimation of the distance of Buseima from El Harrash, and hence it would appear reasonable to think that there was some error either in Stecker's observation or (what is more likely) in his reduction of it. This point is referred to further on in the discussion of the position of Boema (p. 380).

Kufra (Kebabo of Rohlfs).—The name "Kufra" is now generally applied, not to the whole of the Kufra group of oases as was done by Rohlfs in 1879, but specially to the area called Kebabo by that traveller.

The seat of local government and principal settlement is the walled town of Taj, situated on a rocky cliff overlooking the depression of the oasis proper which lies to the south and contains the villages of Jof, Buma, Boema, El Zurruk, Talalib, and Tollab. Hassanein Bey carried out latitude observations at Taj, and proceeded 3 kms., on a bearing of 16° west of south, to Jof, from which place he made very careful estimations of the distances and

bearings of the other villages of the oasis, which has enabled their relative positions to be plotted on the map with much closer approximation than had hitherto been possible.

Considerable interest attaches to the position of Boema, the easternmost village of Kufra, for it was here that Stecker camped with Rohlfs and made his observations for latitude and longitude in 1879. Hassanein Bey found Boema to lie 2 kms. from Taj, in a direction 54° east of true south. Accepting his determination of the position of Taj, this leads to the following position for Boema as compared with that given by Rohlfs:

	Lat. N.			*Long. E.*		
	°	′	″	°	′	″
Boema, according to Hassanein Bey	24	13	8	23	24	40
,, ,, Rohlfs*	24	31	38	23	12	40
Difference		18	30		12	0

Hassanein Bey thus places Boema some 40 kms. south-south-east of the position assigned to it by Rohlfs from Stecker's observations. The remarkable thing about this large discrepancy is that it is chiefly in the latitude, which was directly observed by Stecker at Boema itself, and by Hassanein Bey at Taj, only 2 kms. away from Boema. I have not been able to find any details of Stecker's observations, except that they were carried out with a "prismatic circle." But I have subjected the original records of Hassanein Bey's observations for time and latitude at Taj to very careful examination, and there is overwhelming evidence that his latitude for that place cannot be in error by more than 1′. He observed the altitude of *Polaris* at Taj on no fewer than six different nights, with a watch whose error on local time was accurately known from sun and star observations carried out on the same dates. From the internal evidence of the observations themselves, the watch-error at the time of sighting *Polaris* cannot on any occasion have been uncertain by more than two seconds, which would not, of course, sensibly affect the latitude found; the recorded magnetic bearing of the star sighted, as well as its rate of apparent motion, proves that the star used for latitude in each case was really *Polaris;* and the greatest difference of any single observed latitude from the mean of the six nights' observations was only 15″, the average departure of a single observation from the mean being 12″. Hassanein Bey's latitude of 24° 13′ 47″ for Taj can therefore be unhesitatingly accepted as correct within 1′; and since there is not room for an error of even this amount in his estimation of the short distance of Boema from Taj, it becomes absolutely certain that Rohlfs' latitude for Boema is over a quarter of a degree too high.

It is curious to notice that in the case of Buseima (p. 379) the discrepancy of 13′ 31″ between Rohlfs' latitude and that estimated from Hassanein Bey's recent work is of the same order and of the same sign as that found at Boema; and that a negative correction equal in amount to the sun's semi-diameter would in each case bring the results of the two observers into fairly close agreement. The explanation hence suggests itself that Stecker may have determined his latitudes by observation of the upper limb of the sun at noon, and both at Buseima and Boema failed to correct the measured altitude for the semi-diameter, thus making both latitudes 16′ too great. A mistake of this kind, as every scientific traveller knows, is very easily made in hurried reductions in the field; and at the time when Stecker carried out his observations and calculations in Kufra, both he and his brave leader were in imminent peril of losing their lives at the hands of treacherous Badawi.

* *Mitt. Afrik. Ges.*, Band ii., 1880-1881, p. 25.

BIDIYAT FAMILY AT BAO

BIDIYAT MEN AT ENEBAH

MEN OF THE SORAN TRIBE AT OWENAT

THE WELL AT ERDI

A similar explanation may account to a large extent for the discrepancies of longitude at the two places. Thus, according to Hassanein Bey's work, Rohlfs' longitude for his camp at Buseima is 9′ too far east, and that for his camp at Boema 12′ too far west. We have only to assume that Stecker observed the sun's lower limb in the morning at Buseima, and the upper limb in the afternoon at Boema, for finding the local times, and in each case omitted to correct the observed altitude for semi-diameter, to account pretty completely for both discrepancies of longitude.

The puzzling thing about the above explanation of the errors of Rohlfs' map is that Rohlfs actually travelled the distance between Buseima and Boema, and estimated it at 120 kms.,* whereas Hassanein Bey's positions would indicate that the true distance is 40 kms. greater. But as Rohlf's statement of the distance was obviously written after Stecker had determined the positions of the places astronomically, it is probable that he obtained his 120 kms. by calculation from the astronomical positions, rejecting any rough estimate he may have made of the distance from his times of marching. Both Hassanein Bey and Mrs. Forbes had considered that the true distance was much greater than 120 kms. when they traversed it in 1921; but as on that occasion no observations for position were taken, it remained uncertain whether either Buseima or Boema had been wrongly placed on Rohlfs' map. It is now practically certain that both were wrong.

As regards the level of Kufra, it is satisfactory to notice a very close agreement of Hassanein Bey's observations with those of Rohlfs. Hassanein Bey's barometer-readings at Ezeila, to the south of Jof, give 389 metres for the level of that place, and he estimates that Boema lies some 10 metres higher; this would give about 400 metres for the altitude of Boema, a figure identical with that found by Rohlfs. Taj, which has been built on the cliff north of Jof, since Rohlfs' day, is found to be 475 metres above sea-level from a series of aneroid-readings extending over a fortnight. The outlying villages of Kufra which lie north of Taj are lower than Taj itself, but substantially higher than the southern villages of Kufra; Awadel is 434 metres above sea, and Hawari and Hawawiri are about the same altitude.

There is also fairly close agreement as to the extent of Kufra from north to south. Rohlfs' map makes the extent in altitude between Hawawiri and Tollab to be about 35 kms., while Hassanein Bey makes it 30 kms. But when we come to the distance over which the villages extend from east to west, there is a much graver discrepancy. Rohlfs makes the extent from east to west (Buma to Tollab) about 40 kms., while according to the latest estimations by Hassanein Bey the true extent is only about 21 kms. As Rohlfs appears to have located many of the villages on his map merely from Arab statements, and not from careful personal estimation as did Hassanein Bey, we need have no hesitation in accepting the latter's relative positions as by far the more nearly correct, and hence concluding that Rohlfs' map gives an east-and-west extension which is nearly double the truth.

The error in east-and-west extension (so far as concerns the placing of the villages, not the extent of the vegetation) is even greater on the map prepared by me and published by Mrs. Forbes in 1921.† This is due to the distance between Jof and Tollab having been much overestimated on the former journey; it was given to me as about 42 kms., while according to Hassanein Bey's latest estimation it is only 20 kms.

* *Mitt. Afrik. Ges.*, Band ii., 1880–1811, p. 23.

† *Geographical Journal*, vol. 68 (1921), p. 248.

A matter which will at once strike the eye of any one who compares Hassanein Bey's latest map of the Kufra villages with that published by Mrs. Forbes is that in the later map a place called Ezeila is shown south of Jof, while in the earlier map (which was prepared from Hassanein Bey's own data and rough sketches) Ezeila is shown north of Hawawiri. The explanation is that there are *two* Ezeilas. The name "Ezeila" is applied locally to any outlying well (usually with a clump of palms) which forms the last watering-place for caravans leaving the oasis. Thus the northern Ezeila is the last well for a traveller leaving Kufra to go north-eastwards towards Jaghbub, while the southern Ezeila is the last well in Kufra for any one going south towards Wadai.

From the southern Ezeila of Kufra to Arkenu is 266 kms. in a nearly south-easterly direction, and there is no water or grazing on the way. From Arkenu to Owenat is a further 42 kms. in a slightly more southerly direction.

The Oases of Arkenu and Owenat.—One of the most interesting and important results of Hassanein Bey's expedition is the confirmation of the real existence of the Oases of Arkenu and Owenat, and a fairly exact determination of their positions and altitudes. There has long been a tradition that two oases existed in or near the south-western corner of Egypt. Thus the map of Africa on a scale of 1/4,000,000 published by Justus Perthes of Gotha in 1892 shows an unnamed small oasis and well in lat. 21° 51′, long. 23° 3′, and another "uninhabited oasis," also unnamed, about 48 kms. due east of it in lat. 21° 50′, long. 23° 29′. Both these oases were doubtless placed on the map from vague Arab statements; they appear not to have been previously visited by any explorer, and indeed their very existence was so doubtful that they have not been shown on the maps either of the English or of the French General Staff.

I have not been able to trace any published reference to the existence of Arkenu, but that of Owenat has been mentioned in recent papers by Mr. Harding King and Lieut.-Col. Tilho. In Mr. Harding King's paper of 1913* on "The Libyan Desert from Native Information," he states that he heard of a place called "Owana or "Owanat," about halfway along a road from Merga to Kufra, where there is a well and green grass after rain. The map appended to his paper shows that Mr. Harding King's estimate of its probable position was lat. 21° 37′, long. 24° 45′, which differs by nearly 130 kms. from the nearer of the two oases shown on the above-mentioned German map.

Lieut.-Col. Tilho, who carried out exploratory work in Tibesti, Erdi, Borkou and Ennedi in 1912–1917, mentions† "the still unknown massif of El Aouinat, situated approximately between the 22nd and 23rd degrees of latitude north and the 24th and 25th degrees of longitude east" and a route he heard of from Aouinat to Merga.

Hassanein Bey's observations give for the positions and altitude of his camps at Arkenu and Owenat:

	Lat. N.			*Long. E.*			*Metres above sea.*
	°	′	″	°	′	″	
Arkenu	22	12	32	24	44	15	598
Owenat	21	52	29	24	54	16	616

Thus Owenat is only some 34 kms. from where Mr. Harding King guessed its position to be from his guide's statements, but it is outside the somewhat wide limits of latitude indicated by Lieut.-Col. Tilho, and is nearly 150 kms.

* *Geographical Journal*, vol. **42** (1913), p. 282.

† *Geographical Journal*, vol. **56** (1920), p. 98.

from the place marked "uninhabited oasis" on the German map; while Arkenu, which is presumably the small oasis marked to the west of the "uninhabited oasis," is now proved to be some 180 kms. from where it is shown on that map.

It may be remarked that Arkenu is well within the boundaries of Egypt, while Owenat is a short distance over the boundary, in the Anglo-Egyptian Sudan.

The principal interest in these places lies in the possibilities they open up for further exploration of the south-west corner of Egypt, which has hitherto been inaccessible to military patrols, and even to the boldest of explorers, by reason of the absence of any certain knowledge as to the existence and position of permanent water-supplies. Now that Arkenu and Owenat are exactly located, and the existence of drinkable water in reasonable quantities, it may be possible for a traveller from Egypt to reach them and procure the necessary water-supplies for his return journey. I say it *may* be possible, for there are still great difficulties about access to Arkenu and Owenat from Egypt, although both the compilers of the German map and Mr. Harding King were informed that an old track to Egypt runs from Owenat. According to Mr. Harding King's informant, the track runs to Dakhla Oasis, which is a distance of some 600 kms. through a waterless desert, and consequently the journey between the two places is a very formidable undertaking for camels, even in winter; while the suitability of the ground for motor cars, especially in the mountainous region round the oases themselves, is as yet unknown.

An interesting feature of Arkenu and Owenat is that they are not depressions with underground water-supplies, like all the other oases of the Western Desert of Egypt, but mountainous areas where the water is dependent on local rainfall and collected in natural basins in the rocks.* The Nile Valley in the same latitudes has practically no rainfall, but here, some 700 kms. westward into the Sahara, there is sufficient rain to maintain perennial though limited supplies—at Owenat even sufficient for the needs of a settlement of some 150 Badawi—and at certain seasons to provide grazing for animals in the valleys and lowlands. The ground-level in this region is high (600 metres above sea-level), but the mountains near the oases rise to heights of over 1100 metres above the sea, and it can hardly be doubted that the rainfall is connected with the orography, the mountains attracting or helping to form clouds. In this connection it is worth noting that in the more open country further south, as well as in that to the north, the absence of vegetation shows that rainfall is evidently much scarcer than in the mountains around the oases; also that Owenat, where the mountains are higher than at Arkenu, possesses better and more abundant water. The conservation of the water through the dry season is partly conditioned by the almost impermeable nature of the crystalline rocks composing the mountains, and partly by the sheltered position of the pools in the rocky gullies, which diminishes evaporation.

The full extent of the mountains of Arkenu and Owenat is not yet known, but they cover at least 1000 square kms. Hassanein Bey's main route lay along the western feet of the masses, so that their western limit is

* Though rare in the Western Desert of Egypt, these rock-basins are common in the mountains of the Eastern Desert near the Red Sea, where they are called "galts." See my 'Geography and Geology of South-Eastern Egypt' (1912), p. 240. They are also abundant in the Erdi and Ennedi regions of French Equatorial Africa, as we know from the explorations of both Lieut.-Colonel Tilho and Hassanein Bey.

ascertained, as also their north-and-south extension; but their eastern limits in Egypt are unknown, and it is not yet certain whether there may be a continuous chain of hills connecting the two masses to the east. Hassanein Bey made a round reconnaissance extending some 40 kms. eastward of his camp at Owenat, without reaching the limits of the mass. The mountains are visible from great distances from the north and south, Arkenu having been sighted from at least 60 kms. north, and Owenat remained visible for at least the same distance on the track southward from it. There is a possibility that the mountains may be less conspicuous to a traveller approaching from the east, owing to their breaking up into smaller hills and the ground on that side of them being higher and falling away gradually towards the Nile; but this must remain uncertain until further exploration is undertaken.

From Owenat to Erdi "well" is a journey of 430 kms. in a south-south-westerly direction, the first 284 kms. being in the Anglo-Egyptian Sudan, the remaining 146 in French Equatorial Africa. There is no water in all this stretch, but patches of dried grass were met with at intervals in the latter half of the journey, and some 25 kms. before reaching Erdi the valleys were full of green grass. Thus the northern limit of the equatorial rain-belt hereabouts is approximately in lat. 18° 50′.

Erdi.—Erdi appears to be the name given to an extensive tract of country stretching between the 21st and 24th meridians of east longitude, rising gradually southwards and ending in a broken east-and-west escarpment in about lat. 18° 30′. The water-source visited by Hassanein Bey, called by the guide "Erdi Well," is in lat. 18° 31′, long. 23° 10′, and is 958 metres above sea-level. It is not really a well, but a rock-pool, similar to those of Arkenu and Owenat; the water is good.

Hassanein Bey's "Erdi Well" is close to the locality marked "Erdi-ma" on Lieut.-Col. Tilho's map of 1920, but it appears not to be the same water-source as the one visited by that traveller. Erdi well is at the head of a small valley draining northwards, and one has to ascend the hills to a height of 1020 metres above sea and cross a stretch of broken plateau before reaching the southward drainages which cut back into the scarp. Over this broken plateau Hassanein Bey proceeded in a south-easterly direction, descending the scarp in lat. 18° 25′, long. 23° 20′. The level at the foot of the scarp was 790 metres, so that the scarp hereabouts is some 230 metres in height.

After descending the Erdi scarp, Hassanein Bey's track southwards across the great sandy depression which separates the Erdi plateau from that of Ennedi, to Agah (88 kilometres from his camp north of Erdi Well), appears to have been almost parallel to, and some 20 kilometres east of, that followed by Lieut.-Col. Tilho in 1914.

Agah.—The water-source of Agah is a rock-pool similar to that at Erdi; but the water is bad, owing to fouling by animals. The pool is some 6 kms. up a valley cutting back northwards into the scarp which faces that of Erdi. The position found for the pool at Agah lies some 24 kms. from the "Aga Spring" shown on Lieut.-Col. Tilho's map. There are possibly several springs and pools among the hills in this neighbourhood, all bearing the same name, which would explain the apparent discrepancy.

From Agah the track to Enebah (65 kms.) runs in a rather zigzag course with a general southward trend. For the first 10 kms. beyond the pool, the track ascends the valley; then, mounting rapidly, it soon reaches altitudes of over 1000 metres on the plateau.

Enebah.—Here is a small settlement of Badawi and a well of good water about 28 kms. east of the wells of Keita shown on Lieut.-Col. Tilho's map, on the same high plateau.

From Enebah to Bao is 120 kms., by a rather zigzag track in a general south-south-westerly direction over an undulating and hilly plateau. The greatest altitude recorded by Hassanein Bey during his entire journey, 1184 metres above sea, was reached at a point on the road about 18 kms. from Enebah. This altitude (3884 feet) is slightly higher than that (3600 feet) which Lieut.-Col. Tilho records as his maximum on the same (Erdebe) plateau at a point further west; so that the plateau probably increases in height to the eastward. The Kaptarko Valley was crossed about 47 kms. further on, and it is interesting to note that Hassanein Bey's data give a position for this which is very close to the "Kapterko" of Lieut.-Col. Tilho's map.

Bao.—Hassanein Bey's Bao is not the "Bo" visited by Lieut.-Col. Tilho, which lies over 100 kms. further north, but the place called "Orobo" on Tilho's map and "Bao" on the map of Wadai and Darfur which was attached to the Convention between the British and French Governments at Paris in 1919; this is evident from the following comparison of Hassanein Bey's position with those scaled for the above-mentioned places from the maps referred to:

	Lat. N.			*Long. E.*		
	°	′	″	°	′	″
Bao (Hassanein Bey)	16	28	24	23	1	47
Orobo (Tilho)	16	30	0	22	59	0
Bao (Convention-map)	16	28	0	23	4	0

The wells of Bao are at the head of a small valley draining northwards, in which shrubs and trees are plentiful. There are several wells, with perennial supplies, though the water becomes scarce in the dry season and the wells have then to be deepened.

From Bao to Furawiya is 145 kms. in a south-south-easterly direction, over ground partly covered with grass and small trees. About 55 kms. before reaching Furawiya, Hassanein Bey passed close to a hill called Tameira, on which is a sign-post, formed of a dead tree, marking the boundary between French and Anglo-Egyptian territory. No astronomical observations were taken here, but Hassanein Bey's adjusted traverse-data indicate the approximate position of the hill to be lat. 15° 48′ N., long. 23° 27′ E. The Wadi Hawar ("Howa" of the Anglo-French Convention map) was crossed about 7 kms. beyond Tameira Hill.

Conclusion.—In concluding this analysis of Hassanein Bey's results, the reduction of which has occupied a large part of my time for over two months, I may be permitted to remark that his expedition appears to me to be an almost unique achievement in the annals of geographical exploration. The journey of 3345 kms. from Sollum to El Obeid, most of it through inhospitable deserts sparsely inhabited by fanatical and predatory tribes, is one which, without a strong military escort, could have been undertaken only by a Moslem, and by one of remarkable grit, tact, and perseverance. But Hassanein Bey has not only accomplished this difficult journey and brought back interesting descriptions and photographs of the country through which he passed. Before setting out from Cairo he had applied himself strenuously for several weeks to acquiring facility in the use of the theodolite, and instruction in the particular methods of reconnaissance-survey best adapted for exploration of the kind on which he was to embark; and throughout his

travels he made excellent use of the surveying knowledge thus acquired. How complete and accurate were his observations will be obvious from the foregoing analysis; and the really remarkable thing is that he managed somehow to carry out all this observation single-handed, and to maintain the continuity and accuracy of his measurements and records over the distance of more than 2000 kms. which separates the points on his route whose positions were previously known. Thanks to the detailed and systematic character of his observations, their reduction has been a pleasant labour, and it has been comparatively easy to map his route and the newly discovered places along it with a high degree of accuracy.

The principal additions to our knowledge of North-Eastern Africa which have resulted from the expedition are:

(1) The true positions of Zieghen and Kufra, resulting in changes of about 100 and 40 kms. respectively from the positions hitherto assigned to these places on maps of Africa.

(2) The discovery of the Oases of Arkenu and Owenat, previously unknown, and the determination of their positions and approximate extent, thus opening up possibilities of new desert travel from Egypt into regions of the Libyan Desert still unexplored.

(3) The discovery of a route from south-western Egypt across the Erdi and Ennedi plateaux of French Equatorial Africa into Darfur, and the positions of the water-sources along it. Incidentally, this establishes a connection with, and extension of, Lieut.-Col. Tilho's recent brilliant explorations in the French Sudan.

(4) The determination of careful barometric levels along the entire route, affording valuable information on the orography of a vast region of which little was previously known, and confirming Lieut.-Col. Tilho's conclusion that there is no possible drainage-outlet from Lake Chad in an easterly direction.

CONCLUSIONS DERIVED FROM THE GEOLOGICAL DATA COLLECTED BY HASSANEIN BEY DURING HIS KUFRA–OWENAT EXPEDITION

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BEFORE dealing with the facts ascertained I would desire to congratulate Hassanein Bey on the successful accomplishment of an expedition which has given us knowledge of a large tract of country hitherto unknown to geographical science. Those of us who have a slight acquaintance with desert travel will appreciate the fact that he should have covered 3500 kms. over an almost waterless waste in a region which from religious or political causes is practically closed to a European explorer. It has often meant weariness of body and anxiety of mind, though no doubt he has been compensated by the freedom of feeling engendered by free wind-swept spaciousness and by the constant interest of new discovery.

Hassanein Bey has shown a keen desire to obtain data which would be of scientific value, and consequently has collected specimens and taken photographs which might enable those familiar with the desert geology in Egypt to arrive at conclusions as to the geological nature of the country traversed. Mr. Moon has examined these specimens in my absence, and his notes and conclusions are attached.

The following points are those which have struck me most forcibly in looking over the specimens and photographs brought back by Hassanein Bey:

(1) Between Siwa and Jaghbub large specimens of petrified trees were noted and photographed. This is of interest as showing the wide extension to the west of the so-called "petrified forests." It emphasizes the desirability of extending the examination of the southern edge of the Cyrenaic scarp to the western boundary of Egyptian territory, including the portion now marked "unexplored" on the 1 : 1,000,000 geological map of Egypt.

(2) The beautiful specimens of the Miocene oysters *Ostrea Virleti* and *Ostrea digitalina* indicate clearly that Jaghbub is on the same formation as that of Siwa, viz. Middle Miocene, while the further continuation of these strata towards Jalo is indicated by Specimen No. 3.

(3) At a point a little south of lat. 28° N., a collection was made of hard limestone. A very shelly piece among them may be Miocene, but the others might well form part of the Eocene or Cretaceous members which are so well developed on the same latitude to the east of the Egyptian boundary. The absence of type fossils in the rocks renders further identification impossible.

(4) Between March 20 and 24 Hassanein Bey was crossing a flat plain. The question arises whether this might not be due to erosion of the finer clays and sands which so often lie between the hard Cretaceous limestone and more compact members of the Nubian Sandstone series.

(5) Be this as it may, as indicated by Mr. Moon, the Nubian Sandstone proper was met with in typical form a little north of El Harrash (Zieghen). The specimens obtained from this point onward to the junction with the igneous rocks about 30 kms. north of Arkenu are all varied members of the same sandstone formation which in Egypt proper and the Sudan spreads over enormous areas.

(6) Great interest attaches to the discovery of typical granite in the Oasis of Owenat and Arkenu. The main rock is of pegmatitic type, being composed of well-shaped felspars, glassy quartz, and hornblende. A point brought out by the photograph is the intense action of temperature variation on these igneous rocks. The whole of the hillside is strewn with gigantic boulders, some of which have been split into large pieces which obviously once formed part of the same block.

As regards the nature of the relations between the granite and the Nubian Sandstone, it is to be noted that the granite difference of level might be explained (*a*) by the existence of a fold, (*b*) by the presence of a fracture line or fault, (*c*) by intrusion of the granite when in a molten condition into the overlying sandstone.

After conversation with Hassanein Bey, and a closer examination of his photographs from this point of view, one is led to the following conclusion:

(1) A fold seems possible, because the sandstone (which dips or slopes off the granite in certain folds in the south of Kharga Oasis) is seen to be obviously dipping towards the spectator in the cinema photograph of camels coming through the valley of Owenat. Taking (*c*) first, we have no proof anywhere in Egypt that granite has been intruded into the Nubian Sandstone, in all cases where the relations are clearly displayed, the granite having obviously been worn down before the sandstone was deposited on it.

(2) We are consequently disposed to adopt the view, pending further study, that the differences of level may be due to the existence of a fold. The alternative would be the presence of a fracture line, along which the granite

has been pushed up in a solid form to a higher level than the sandstone which normally overlies it, or the sandstone has been led down along the line of weakness against the granite.

A very interesting feature is the presence of well-made drawings of giraffes and ostriches on the granite boulders. As Hassanein Bey points out, the camel is absent, and it is to be regretted that there are no pictures of human beings. These "graffiti" may be of ancient date, being drawn at a period when rainfall was greater in this portion of North Africa than it is at present.

Hassanein Bey's expedition has thus indicated that both the Miocene strata in the north and the great Nubian Sandstone formation further south continue well to the west of the western Egyptian boundary with unchanged characteristics, while the discovery of the granitic oasis, as I understand within the boundaries of Egyptian territory, opens up the possibility of developing alternative routes to Darfur from Dakhla Oasis, and also indicates a water base of great importance in connection with the exploration of the unknown territory lying west of the route followed by Hassanein Bey. Its further study from the geological standpoint would be of great interest.

NOTES ON THE GEOLOGY OF HASSANEIN BEY'S EXPEDITION, SOLLUM–DARFUR, 1923

F. W. Moon

HAVING been requested by Hassanein Bey, in the absence of Dr. Hume, to report upon the interesting geological specimens collected by him on his recent exploratory tour through the Western Desert from Sollum, on the southern shores of the Mediterranean Sea, to Darfur in the Sudan, I have much pleasure in submitting the following short summary of the main features of the journey from a geological point of view, as deduced from the specimens collected.

Although the specimens are small and, in the case of the igneous rocks much weathered, yet for all intents and purposes they are quite sufficient to enable one to make deductions and conclusions as to the main geological formations passed over.

As the explorer explains, there was not the freedom of transport he would have desired for making a larger collection of full-sized specimens, nor did he wish to incur the displeasure of those who formed his escort by seeming to do anything that might appear in any way suspicious, such as the constant breaking and collecting of stones.

From the tabulated list of specimens herewith appended, it may be seen that the beginning of the journey was made over Miocene formations indicated by fossil oysters and pectens (identified as *Ostrea digitalina*, *O. Virleti*, *Chlamys zittteli* and others), of which there are seven valves of the former, two of the second, two of the third, and five which resemble *Chlamys sub-malvinæ*.

The Miocene formations continue through Siwa, Jaghbub, and Jalo, and far southwards to a point about 180 kms. to the south of Jalo (see specimens 1–4), where the last Miocene specimen (No. 4) was picked up.

At this point begins a wide barren stretch of flat and desolate country, devoid of rocks of any particular geological interest beyond the thin covering

of "sand and alluvium" which extends for nearly 200 kms. (four days of monotonous marching) along the route to the south.

Then, when about 50 kms. north of Zieghen, the explorer noticed that the aspect of the country took a sudden change; the light yellow of the Miocene limestones and desert sands gave place to brighter, more varied and highly coloured scenery, which the specimens show was due to the approach of the Lower Cretaceous "Nubian" Sandstones, which, wherever they occur, add beauty to the landscape in unbelievable brilliancy and variety of colouring.

Although greens and blues are sometimes observed, red is the dominant colour, all shades of pink, terracotta, maroon and brick-red are blended together, and umbres and ochres are sometimes present.

Thus we are provided with a point well westward of any hitherto known on the northern limits of the "Nubian" Sandstone; in other words, the evidence suggests the continuation westwards by some 600 kms. of the "Nubian" boundary shown on the existing 1/1,000,000 coloured geological map of Egypt (1910).

Mention may here be made of the apparent absence of specimens definitely representing the younger Cretaceous rocks which are shown coloured green, on the map just referred to, to the east; but this may be readily accounted for by the presence of the expansive plain passed over between Jalo and Zieghen, the "sand and alluvium" covering of which is quite sufficient to hide all evidence of the younger rocks of that age.

Another question rendered obscure by the presence of this large flat expanse of "sand and alluvium" is the exact position of the southern limits of Miocene formations. If we assume (which seems to be the case) that the point, 180 kms. to the south of Jalo, where the last Miocene specimens were collected, be the southern boundary of the Miocene, then we find that the distribution of that formation as now suggested is of particular interest as (1) indicating a western extension of the general outline of the ancient Mediterranean Ocean in Miocene time; and (2) adding extra weight to our conceptions as regard the period (in geological chronology) of the Egyptian–Sinai uplift which caused the elevation of land involving a considerable portion of Egypt in pre-Miocene times, and ultimately defining the shores of the Miocene Sea more or less as we now follow it from this newly discovered spot between El Harrash (Zieghen) and Jalo to a short distance east of Siwa from where it runs north-eastwards to the 30° lat. along which it continues with little variation to Suez.

It would appear that all Egypt lying between the Miocene Gulf of Suez in the east and the Siwa–Zieghen Miocene shore-line in the west and southwards was dry land in Miocene times, and therefore exposed to denudation extending over a vast geological period during which the "Nubian" Sandstone and younger Cretaceous rocks were laid bare and in a position to have Miocene strata laid down upon or against them.

The "Nubian" Sandstone, as indicated by the specimens 5–10, shows identical characteristics to those exhibited wherever it occurs in Egypt or Sinai. It is a sandstone consisting in the main of more or less fine rounded grains of pure quartz, through which is distributed, in greater or lesser proportions, larger grains or pebbles. In cases where the latter predominate a pudding-stone or conglomerate results; where the larger grains are sparsely distributed a porphyritic appearance is suggested.

The cementing material, which may be either calcareous, siliceous, or ferruginous, is the colour-imparting medium, the depth of colour depending

upon the amount and composition of iron oxides present in it, and when this material is weathered, washed out, and accumulated into pockets it becomes when finely ground suitably adapted for the manufacture of paints.

The "Nubian" Sandstone continues south of the Miocene–Nubian boundary above referred to, to a point some 15 kms. north of the Arkenu Mountains.

Approaching this point, still another change in the general aspect of the country met the eye of the explorer: the brighter colouring of the sandstones gave place to the duller browns, greys, and blacks of an abrupt range of igneous hills, the position on the ground where the igneous rocks come up through the Nubian Sandstones being approximately 25 kms. north of Arkenu.

The changes of scenery in passing from one formation to another are strikingly seen in the excellent collection of photographs procured by Hassanein Bey, who is to be highly complimented on the success he obtained under great difficulties and inconveniences.

Judging from the specimens 11–22 submitted for examination, the igneous rocks, of which the Arkenu–Owenat hills are composed, consist mainly of coarsely crystalline granites and syenites varying in texture and appearance, and through them run intrusive veins of finer-grained dyke rocks.

The Arkenu hills are mostly composed of rocks represented by specimens 12 and 14, which are really somewhat similar in composition.

No. 12 consists of a holocrystalline aggregate of large crystals of a light grey (possibly a decomposed or kaolinized orthoclase) alkali-felspar, which constitutes the main bulk of the rock. No quartz is visible in the hand specimen, which is greatly weathered, and only gives a specific gravity of a little over 2·5. Small crystals of dark greenish hornblende are well formed, and occur in fewer numbers than in specimens 17 and 21, which are representatives of the rock-mass of the Owenat hills to be described presently.

Specimen 14 is an unweathered grey rock chiefly composed of a mottled grey alkali-felspar, with hornblende crystals in similar numbers to those in specimen 12.

The microscopic examination of a rock-section made from specimen 14 corroborates the above description, but introduces the possibility of the presence of nepheline in granular-like patches in the slide, which correspond to darker slightly lustrous areas in the hard specimen; however, no nepheline has been actually identified.

Specimens Nos. 12 and 14 may therefore be called *syenites*.

Running through the syenites of the Arkenu hills are veins of intrusive rocks represented by specimens Nos. 11, 13, and 15, and no doubt many others occur.

Specimen No. 11 represents a vein of a hemicrystalline, hard dark green rock weathering brown on the outer surface, with innumerable small dark specks which are scarcely discernible in the unweathered portion of the specimen.

Under the microscope this rock is found to be of considerable interest. It consists of an aggregate of small phenocrysts of idiomorphic felspar, which in places assumes the appearance of a crypto- or microcrystalline felspathic matrix crowded with acicular crystals of a green mineral resembling ægirine. The latter are in places irregularly distributed, but in areas where the felspar occurs in roughly rectangular or lozenge form, the ægirine microlites are crowded round the edges of the latter.

No quartz is noticeable in the rock-slide, and the rock may be tentatively determined as an *ægirine-felsite*, apparently similar to a rock described and figured in Harker's 'Petrology for Students.'

A second vein in the Arkenu hills is represented by specimen No. 13, which is a brownish *quartzite*.

The third vein is indicated by specimen No. 15, which is a dark grey laminated rock, weathering to reddish-brown, very fine in texture, with small clear crystals of phenocrysts sparsely disseminated through the groundmass. The rock-slide shows, under the microscope, a great similarity to specimen No. 11 as described above. The felspar here, however, forms a much finer crypto-crystalline groundmass than in the former, and the ægirine microlites are smaller, tapering, and not so well formed. This rock may also be tentatively called a fine *ægirine-felsite*.

The Owenat hills are mainly composed of rocks represented by specimens 17 and 21, the chief constituent of which is a grey alkali-felspar (possibly orthoclase with some microcline). Quartz is well represented in idiomorphic forms; no mica is noticeable in the hand specimens, but many well-developed prismoidal crystals of very dark or dark green hornblende are thickly distributed throughout the mass.

No slide was made of these specimens owing to their fragile condition due to weathering, but the rock may be determined as a coarsely crystalline grey *hornblende-granite*.

Specimen No. 18 is another representative rock from, and constitutes a considerable bulk of, the Owenat hills. It may be termed a *red granite*, approximating to an aplite with very little mica, which decomposes and forms oxides of iron which have stained the rock a brownish-red; quartz and felspar form the main bulk of the rock.

As in the case of the Arkenu syenites, so here in the Owenat granites we find other examples of endogenous veins running through the parent rock, represented by specimens 16, 19 and 22.

Specimen No. 16 represents a vein of purplish *felsite*, in the felsitic groundmass of which occur phenocrysts of idiomorphic felspar.

Specimen No. 19 represents a vein of pure white granular *quartz rock* which occurs in and may have been the cause (through denudation) of the cave found in the foothills of the Owenat range.

Specimen No. 22, found at Garet Shuzzu, is a typical *quartzite* which may also occur as a vein in the granites.

Two specimens found inside the cave in the Owenat oasis are of particular interest. These specimens are Nos. 20 and 21. The former, a laminated *travertine*, could only have been deposited from running water, as the formation of ripple-markings confirms; and from notes made by the explorer at the time of his inspection, we learn that there was quite a lot of it lying about on the floor of the cave. Under the microscope spheroidal structure is displayed, representing the ripple-markings, and in the matrix of calcite many fragments of quartz, felspar, etc., are conspicuous, these having been derived from the denuding granites. No organic remains were observed.

The second specimen (No. 21) is a fragment of the hornblendic-granite of which the Owenat hills are chiefly composed, and which forms the roof of the cave; this is coated on one side with a thin black iron-manganese film, similar to the well-known deposit on the rocks in the Nile at or near the Aswan dam.

This whole igneous area, which includes the newly discovered mountains

and oases of Arkenu and Owenat, is possibly of limited extent, and occurs in, and is possibly surrounded by, a much wider expanse of "Nubian" Sandstone, in a similar manner to several other such areas already shown on the one-million geological map of Egypt.

Judging from other known similar occurrences where igneous rocks appear surrounded by "Nubian" Sandstones, we may infer that the latter were deposited upon the ancient igneous rocks which subsequently rose vertically, bending the superincumbent strata over and round them, possibly only to a slight degree in this instance, as none of the photographs show very highly dipping rocks.

On leaving Owenat for Erdi the igneous area is soon left behind. The actual junction between it and the "Nubian" Sandstone (which again forms the surface rock) occurs at a point about 20 kms. south of Owenat, and the aspect of the country again changes from the more uneven weathering of the igneous range of greys and browns to brilliant colourings of the "Nubian" Sandstone which forms a long series of prominent escarpments rising to heights bordering on 1000 metres above the sea between Enebah and Kuttum, after which the ground begins to fall, until El Fasher is reached, where the ground-level is only about 700 or 800 metres in height.

Summary.—The several interesting geological features suggested by the recent expedition may be summarized as follows:

1. That Miocene rocks extend southwards, to or near the 27th degree of north latitude, forming a large bay bordered by older rocks.

2. That the Miocene rocks, resting here apparently upon or against "Nubian" Sandstones, seem to follow the same conditions noticed first by Dr. Hume in the Gulf of Suez region, namely, that they rest upon older and older formations the further southwards they are found; in other words, that prior to the deposition of the Miocene there was a time of denudation which was more effectual in the south than in the north, owing to the fact that in the south was an area of greater uplift.

3. That a large area of "Nubian" Sandstone (Cretaceous) exists south of this latitude.

4. That a newly discovered range of igneous rocks, in the Arkenu hills exists well inside Egyptian territory, and possibly entirely within this "Nubian" Sandstone area, or connected as a tongue to a larger igneous massif lying in the south.

5. That the Cretaceous rocks (younger than the "Nubian" Sandstone) which appear on the coloured Geological Map of Egypt further to the north-east, possibly do not occur along the route traversed, having been concealed beneath "sand and alluvium" areas.

LIST OF SPECIMENS COLLECTED BY AHMED MOHAMMED HASSANEIN BEY IN HIS EXPEDITION FROM SOLLUM TO DARFUR.

No.	*Date.* 1923.	*Locality.* (*As taken from descriptions on labels.*)	*Determination of Specimens.*
1	—	Siwa.	Three crystal fragments of selenite; one pecten and two oyster shells (possibly of Miocene age).
2	—	Jaghbub.	One pecten in a shelly limestone (possibly indicating Miocene age).
3	—	Surface rocks on the way from Jaghbub to Jalo.	One piece of fossilized wood; three loose siliceous pebbles; two long concretions of calcareous grit, and fibrous salt crystal (curved, five inches long).

No.	*Date.* 1923.	*Locality.* (*As taken from descriptions on labels.*)	*Determination of Specimens.*
4	March 20	In Wadi, in small patches.	Two loose pebbles of calcareous grit with quartz grains.
5	March 24	Getting near El Harrash (Zieghen), patches of this strewn (broken) before reaching Halab.	Nubian Sandstone (one specimen).
6	March 28	One day's journey from El Harrash (Zieghen), on way to Kufra.	Hard ferruginous bands from Nubian Sandstone (five specimens).
7	March 29	Garet el Sherif.	Nubian Sandstone (three specimens).
8	—	Gebel el Neri, the garas nearing Hauari.	Ferruginous bands (colour maroon) from Nubian Sandstone (three specimens); one black ferruginous "bomb."
9	—	Kufra (Taj) hills.	Blocks of Nubian Sandstone (three specimens).
10	April 22	Between Kufra and Owenat; specimens from chain of hills crossed that day.	Nubian Sandstone (one specimen); and ferruginous bands from Nubian Sandstone (two specimens).
11	April 24	Arkenu Mountain	Igneous rock (ægirine felsite).
12	— 24	From patches of Arkenu Mountain. There are big hills formed entirely of it . . . on the outside of the mountain.	,, (badly weathered syenite).
13	— 24	From big patches north of Arkenu Mountain.	,, (quartzite vein in).
14	— 25	From Arkenu Mountain itself.	,, (grey syenite).
15	— 25	Found in big blocks buried in the ground on the border of Arkenu Mountain, in the Arkenu Valley.	,, (ægirine felsite).
16	—	Specimen from formations (in layers) found in Owenat big valley.	,, (felsite).
17	—	Owenat Mountain is mostly of this stone.	,, (badly weathered hornblende-granite).
18	—	Stone of which Owenat is generally formed.	,, (badly weathered granite).
19	—	Found inside the water cave at Owenat, near the water-level; plenty of it in small patches.	,, (quartz vein).
20	—	Found inside the water cave at Owenat.	Calcareous deposit from running water (travertine).
21	—	Found inside the water-cave at Owenat, in the roof. Most of the stone of the cave and mountain is of this kind.	Igneous rock (badly weathered hornblende-granite, coated with polished film of iron which may have come from the water).
22	May 8	From Garet Shezzu, near Owenat.	,, (fine quartzite).
23	May 10	Between Owenat and Erdi.	Nubian Sandstone (one specimen).
24	May 13	Found strewn on red sand, getting near Erdi. Nothing but red sand and this stone.	Ferruginous band (containing hæmatite) from Nubian Sandstone.
25	May 16	Erdi hills.	Dark red clay, with small percentage of quartz sand (grinds up into dark brick-red powder).
26	May 16	Stone of Erdi hills.	Brick-red clay, with small percentage of quartz sand (grinds easily into bright brick-red coloured powder).
27	May 19	Agah hills.	Soft, fine, yellow to red, slightly calcareous micaceous sandstone.

THE FIRST CROSSING OF FIJI

Basset Thurston

PROBABLY the first white men to settle down in Viti Levu were one or more of the crew of the *Argo*, wrecked on the Lau Islands in 1800, and several of the sandalwood traders who reached Vanua Levu between 1804 and 1813. Armed with guns and ammunition, they attached themselves to various native chiefs and soon became powerful. Charles Savage, their leader, was killed and eaten by cannibals in 1813, and Connor, the survivor of the band, died in 1840.

Five years before his death, the Wesleyan-Methodists had commenced their endeavours to convert the Fijians to Christianity. Two missionaries landed at Lakemba island, and in 1838 one of them proceeded to Rewa in Viti Levu.

Thenceforth the number of English residents increased so steadily that, in 1858, the Home Government appointed Mr. T. W. Pritchard the first British Consul. Two months after his arrival at Levuka, however, he sailed for England to urge the annexation of the group. The Government, interested by the suggestion, despatched Col. W. J. Smythe, R.A., as Special Commissioner to examine and report upon the condition of the islands.

During the ten months he spent in Fiji, Col. Smythe explored the entire coastline of Viti Levu, parts of the Vanua Levu littoral, and visited most of the smaller islands. He did not penetrate into the unknown interior of Viti Levu—with the exception of a short visit to Namosi, a native town near the headwaters of the Navua river—but confined himself to the coastal belts.

Upon his return to England, the Commissioner's report was such that the Government rejected Mr. Pritchard's proposals.

In 1864 the late Sir (then Mr.) J. B. Thurston, K.C.M.G., was wrecked at Rotumah, an island lying 300 miles to the north of Viti Levu. After eight months he was rescued by the missionary schooner *Dove*, which conveyed him to Levuka.

Mr. Pritchard had been superseded in 1863, and the new Consul, Captain H. M. Jones, V.C., was so impressed by Mr. Thurston's knowledge of the Fijian tongue, that he offered him a position in the Consular Office. The appointment was accepted, and from then until his death in 1897, Mr. Thurston held various offices which culminated in those of Governor and High Commissioner for the Western Pacific.

The interior of Viti Levu was still unknown, and Captain Jones determined to explore it. Accordingly, in July 1865 he set out for the Navua river, accompanied by Mr. Thurston, Mr. Henry Thurston, a doctor whose name has not been recorded, and Charley Wise, a half-caste clerk.

The party proceeded over the same route as that taken by Col.

Smythe, to Namosi, and thence across the hinterlands. Eight days after leaving Namosi they arrived at the village of Navosa, where they were hospitably received by the same chief who, two years later, was responsible for the clubbing and eating of the Rev. T. Baker, the Wesleyan missionary. Three more days of steady travelling brought them to Tavua upon the north coast, from where they returned to Levuka by sea.

Besides their personal baggage and food supplies, each member of the party took mosquito nets to protect himself at night in the Bures or native guest-houses. There appears to have been only one shot-gun among the five, and they relied much more upon a box of fireworks with which they kept the natives impressed.

Mr. Thurston kept a diary containing notes of his observations, which is set out here for the first time.

JOURNAL OF THE EXPEDITION

July 1865.

Friday, 22nd.

Left Levuka with a fair wind and in glorious weather. Forced to go out at the Navoa Passage, when the vagaries of Neptune made Esculapius * sick, but hearing the sounds of eating, he rallied and made a second hearty breakfast. Turtles all around. Harry † lost his hat and caused some delay in recovering it. Passed a small boat bound for Levuka. Entered the Rewa River a little before sunset. We arrived at Robinson's house, and found that he had left for Levuka. Progressed on and arrived at the island of Vositi.‡ We were unable to proceed to the house, so landed at the lower point and walked about 2 miles. Were treated very hospitably by the host, who furnished us all with berths.

Saturday, 23rd.

We arose early next morning. Danford § we found ready to accompany us. Started at 8 o'clock and with a fair wind. Arrived in Suva Harbour.

Put Danford ashore and proceeded to the Inner Harbour. Much doubt about the proper position for a town,‖ as both sides are equally disadvantageous. Returned to the native town of Suva, and found that Danford had made all the necessary arrangements respecting the labour required, and as there were no serviceable canoes, we were obliged to take two additional coolies in our already overcrowded boat—making fifteen in all.

Having a fair wind, we stood over, and with good luck only touched rocks twice. Wind very fresh. Arrived at Eggerstrom's ¶ house after dark. House very small and disorderly. Cotton crops prolific, but blighted by the effects of the strong south winds. Land very fertile and exceedingly picturesque. Mosquitos troublesome. Host has been troubled by a visit from the

* The Doctor. † Mr. Henry Thurston.

‡ An island in the Rewa Delta.

§ A man who lived at Namosi, and who had turned native; known as "Harry the Jew."

‖ Suva, the present capital.

¶ A Dane, who lived at Nagara, Vuya Island, halfway between Suva Harbour and the Navua river mouth.

mountaineers, who had acted most outrageously in stealing his pigs and behaved with great insolence.

Sunday, 24th.

Rose early and viewed the country. Breakfasted, and proceeded on our journey. Arrived at the delta head of the River of Lombau,* and expected to find the natives of Namosi fishing. Proceeded up the river about 4 miles, and were forced to stop as the water became too shallow.

We had not sufficient men to carry our baggage, so prepared our camp and despatched a messenger to Namosi to procure coolies. Prepared a comfortable hut of banana leaves. Made a fire, and collected wild yams, papaws and taro which were growing in abundance on the site of a deserted native town. Bathed in the Lombau and endeavoured to sleep. Fixed Harry's mosquito netting, but in vain.

Monday, 25th.

Passed a restless night, and rose early. Charley shot a large rooster. Waited until noon for the arrival of the porters from Namosi. At last they arrived. Had great difficulty in adjusting the loads and at length started.

Proceeded in a N.W. direction and found the road very bad at the commencement. Floundered along up to our knees in mud for more than a mile. Natives killed a wild cat on the road. We arrived at our destination on the banks of the same River Lombau, supposed to be 19 miles from Namosi.

Found on the road slate, pipe-clay and felspar. Hills gradually rising in successive elevations. Road slightly inclined.

In the evening the natives baked the cat with ferns, of which one of our party partook heavily; likewise of a flying fox. Natives in ecstasy at the brilliant colouring of the mosquito nets.

Tuesday, 26th.

Passed an uncomfortable night. Mosquitos very troublesome. Rose early, and commenced our march through the river-bed. Dog started a Tiri bird, which we failed to secure.

Commenced the ascent of a high mountain and arrived at the summit, bearing from Nalovui, N.N.E. of Vuni-Koro. Descended and passed the Wainiavu.† Fertile valley. Ascended Natilevu and passed the Wainisinga. Passed over another mountain and another river, which discharges into the Rewa. Had a glorious dinner of roast pork, which a native brought from Namosi.

All so fatigued that when we arrived at Kumba-Kumba—the highest mountain on the road to Namosi—we elected to camp out, and found a good location under a shaddock tree. Thank God, no mosquitos.

Wednesday, 27th.

Started for Namosi, 6 miles distant, over the mountain. Came round by Vovua Peak ‡ and saw Namosi lying in the valley beneath us. Scenery very fine.

Precipitous basalt cliffs all around and the peak of Basambasunge § in the

* The Navua river. The upper courses were known as the Wai-ni-kore-levu, the lower as the Lombau or Duba.

† Wai in Fijian means a river.

‡ Now called Voma: 3080 feet high.

§ Korombasambasunge, 3960 feet.

distance. Fine points of scenery. Fertile valley along river bordered with shaddock trees.

Arrived in front of the old Bure Stone, marking human bones in the trees. Dead bodies also. Arrived at the Teacher's * house on the banks of the Wain'dina, and found Danford waiting for us in company of one of the companions of the Chief of Suva, who, along with four others, had taken refuge in the town a short while before.

Received us hospitably, and prepared a dinner of boiled fowls with ferns. Walked along the river to the basaltic cliffs, and met a man with eels; one of a new variety with a red belly. Fine hole for bathing. Returned to the town.

Saw in every tree a number of the bones of bodies which had been eaten. Skulls, pelvises, leg and arm bones filled the boughs.

Dined on stewed pork and taro. After dinner, fireworks caused a great sensation. Arranged for a journey in the morning to Basambasunge.

Thursday, 28th.

Rose early. Bathed. Chocolate spoiled. Started for the mountain with party. Charley remained behind. Passed through a village fortified with pitfalls and bamboo fence. Skulls and bones around. Ascended and descended three hills and saw three streams flowing into the Rewa; largest called Wai-ni-Su. Tedious ascent. Perpendicular climb and precipitous. Sheltered under the rocks, at length, on the summit of the mountain.

Nothing but successive chains of mountains, running east and west. Smoke at N.E. Large mountain towards Ba. Seabirds build on mountain. Caught two green worms. No shells. Several new ferns of unknown type.

Return. Dreadful fatigue. Ate shaddocks. Great thought! No hunger! Great difficulty in proceeding.

Met Charley, who runs along like a lamplighter. Shot a pigeon. Passed woman carrying frogs.† Great fatigue. Drank cocoanuts, and at length arrived at Namosi, dead beat. Distance about 30 miles. Made preparations for passing the night on the mountain, but the prospect not cheering. Damp a little and somewhat windy.

Friday, 29th.

Rose at 8 o'clock. Theatrical entertainment of a snake and two native women.

An embassy arrived from Serua, bringing two whales' teeth,‡ and requesting Karandua to send back some women who had fled. Request refused.

Sauntered about. Bathed. Very fatigued. Not yet recovered. Played whist in the evening.

Saw gum like camphor. Ratan canes. Conger eels in the fresh water. Native rat traps; edible frogs. Cowrie gum. Plague of rats devouring the Indian corn. General formation of the country is gneiss.§ Chief drinks tea with gusto.

Saturday, 30th.

Wet morning. Preparation for a start. Disputes respecting journey. We found that, regarding our arrangements with Karandua, he professes not to be able to send us farther than beyond a village called Vuni-Vutu. With a great

* Native Wesleyan pastor.

† Edible frogs.

‡ He who accepts the present of a whale's tooth must do everything which the donor demands. The presentation may be refused. Fijian custom, called Soro.

§ Mosi is the Fijian word for gneiss formation.

deal of difficulty, we forced the natives to fetch the baggage, and after some time set out.

Rain fell heavily. Road muddy and lay mostly through the bed of a river. Scenery very beautiful. Fogs over the mountains, which obscure the view.

Land fertile and large clearings. Forded a river which runs to Navua. Arrived at a village called Valua, 6 miles from Namosi. Remained in the Bure. Then we progressed further to the village of Lasse-Lasse. Comfortable Bure with good fire to dry our clothes. Large river flowing south; empties itself into the Lombau near Nukuloa.

Sunday, 31*st*.

Wet morning. Rained all night. Fogs all around. Great disinclination to procced. At length decided to remain, and start the next morning over the mountains, and so gain a day's march. Drizzling rain all day. Miserable time in the native Bure.

Saw some fresh bones in the trees. Inquired. Only two months old. Endeavoured to pass the day. Showed no signs of clearing up. River supposed to be flooded. Disinclination of all to sleep upon the wet ground. Good appetites.

Monday, 1 *August* 1865.

Drizzling Started at 9 a.m. Road wet and muddy. Saw a large flight of wild ducks. Forded the river. Passed several houses and deserted plantations, and saw many fine landscapes. Passed beneath the village of Wain'dai, situated upon a very lofty hill. Arrived at our camping-ground, a Bure upon the banks of the river. Crowded house. Thirty-five men in a Bure 10 feet square!

A large eel brought in, in the evening, about 8 lbs. in weight.

Tuesday, 2*nd*.

Beautiful morning, promising a fine day. Slept little and rose early. Breakfasted and started for the road at 9 a.m. Followed the river still north for about 15 miles through a very fertile country, which was entirely deserted. Passed several abandoned villages, the inhabitants of which have been killed and eaten by Karandua's people.

Caught a large snake. Tiresome march. Arrived at our halting-place on the top of a high hill.

Weather very cold.* Raining. Cooked the snake by turning it inside out. Built a comfortable Bure. Dined off stewed pork and turned in early. Drizzling rain all through the night.

Wednesday, 3*rd*.

Left early and climbed a mountain called Dualo, with a stream at its foot called the Wainivau, which flows into a tributary of the Rewa.

Saw a fine grass country lying N.N.W. Waited in a taro clearing for more than an hour, expecting some food, but were doomed to be disappointed, as the bearers mistook the place.

Started again, and ascended another steep hill, and were then forced to descend a precipice.

Scenery very fine. Saw a splendid stretch of land covered with grass, W.N.W., said to extend to the sea. Much clearing here, and seemingly a prosperous community.

* The weather can be very cold in the mountainous valleys of the interior. 40° F. has been recorded.

The young chief's nephew is called the Vasu in this village. Suffers severely from a pain in the back, which delayed his meeting us. We stayed a short time, and then set out again, through very fine country like a park, and at length arrived at the village of Vuni-Vutu, about 15 miles distant from the preceding one. The houses different from those on the coast, being round in shape, with their roofs like inverted mushrooms, stalks and all.

We arrived in the market-place, and awaited the coming of the young chief and his headman, who were engaged in planting.

Weather exceedingly cold, and after getting something to eat we walked up and down, endeavouring to keep ourselves warm, while about two hundred natives gazed on white men for the first time.

The young chief then appeared with two followers whose faces were painted vermilion, with their hair newly dressed, and with coloured tappas * about their waists. Upon this we all moved to a new Bure upon the top of the hill, where the entire male population followed us.

When we had all sat down, the village Talking Man † asked Harry to act as herald, but the latter declined. The spokesman then narrated our wonderful adventures in detail, and stated that we wished to proceed to the north coast, and desired food and lodging. Harry then presented two whale's teeth, and the chief unwound his new tappa and presented it to the village headman. After this we went to the new Bure and found that mats had been arranged for us, and we were altogether content with our lodging; the smoke was disagreeable, however.

Thursday, 4th.

Rose at daybreak and was much struck with the extraordinary effects of the fogs lying in the valley, producing an appearance of snowfields or lakes.

Breakfasted and walked on a little way beyond the village. Returned and made preparations for the ascent of the basaltic cliff behind the village from where the sea may be seen towards the W.S.W. and the S. Had a pleasant climb, and obtained a view of the Western Group from two points, and of Bequa, Kadavu and Ono, from another. Also the mountain ranges near by.

On the way down found some new ferns. Returned to the village. The bottled tongue reported to be bad. Dined on stewed pigeons and pumpkins, and afterwards started for a walk into the grass country. The soil is a vegetable deposit on a bed of ferruginous marl, the same entering into composition with basalt and gneiss. Grass thin, but would thicken with cattle. Scenery very fine on all sides. The rugged edge of Naloto W. by N.

Returned to the village and found supper excellent. Soup very good. Remainder of pigeons.

No signs of cannibalism. Chief denies his people eat men. Denies knowledge of Karandua. After dinner some fireworks. Natives terror-stricken. Refused to come near. Withdrew to their houses.

Retired to rest in my hall along with the doctor.

Friday, 5th.

Fine morning. Cold wintry wind blowing from N.E. Scud flying rapidly. Washed in a small creek and returned to breakfast. Arranged for a sporting

* Tappa is a form of cloth made from the bark of the paper mulberry, after having been soaked and beaten flat with wooden mallets.

† Upon ceremonious visits there is always a talking man, who recounts the visitors' experiences to his chief or chiefs at the top of his voice. Afterwards host and visitors may speak direct.

tour in the valley beneath, in order to see the junction of the river. Met with great opposition on the part of the villagers, who stated that the country was full of enemies, and endeavoured to prevent us setting out.

At length we started, and were accompanied by the chief and his brother. The latter a great nuisance, as he continuously repeated his assertions, and implored us to return.

We descended the hills, and after a long walk arrived at a deserted village in the middle of taro beds. There were here two deserted Bures, surrounded by cocoanut trees and mammie apples. We halted in a grove near the village and ate some of the latter; also some wild lemons and cocoanuts. Saw few traces of wild ducks, and in spite of the natives who followed us we proceeded along the river-bank for a few miles.

Saw a new formation of clay, shale stratified and in parts ferruginous. Cliffs on the right bank of the river composed of this material.

Halted to eat some sardines, and then returned up the river. Hot and tiresome march under a scorching sun. Saw ducks again, but got no chance for a shot. Proceeded up a hill and halted halfway to try the rifle. Bullet shot well.

Returned to camp. Found that the young chief had been using his Vasu rights.* We shot a pig and had a piece of it for dinner. Many ceremonies. Offering of taro. Ate some yams. Beautiful moonlight. Retired to rest.

Saturday, 6th.

Hazy morning. Cool wind from N.E. Bathed and returned to Bure. Found that great difficulty existed in persuading the natives to carry our baggage, as the chief was afraid of offending the townspeople, lest they might desert him for a rival chief.

At length set out over a comparatively level country, until we arrived at a place where a village existed. Here our porters wished to stay and feed, but fearing the difficulty there would be in persuading them forward, we refused the hospitality offered.

Descended a very steep mountain and arrived on the banks of the Wairara, a large stream flowing into Nanoga Bay, and rises to the north-east of Tholo-Vatu.

Lunched in the ravine and bathed. Saw several large black mullet ascending the stream towards the source. Progressed onwards, and Charley shot two wild ducks for the pot.

The river flows through a country composed of shale, clay, slate, conglomerate, rock trachite, and felspar. Saw several stones like opals in the crevices. Gold likely to be found here.†

Passed a village on our right, and after a long march arrived at the village of Tholo-Vatu on a cliff above the river. This village is divided into two parts, one on top of the hill, and the other lower down.‡

* The right of the nephew of the chief to take whatsoever he pleased without objection on the part of the owners.

† Alluvial gold has not been found. Quartz has been discovered, but not in paying quantities hitherto.

‡ A local legend has grown up to the effect that when the chief tried to eat the Rev. Mr. Baker's feet—considered to be the daintiest portion—he broke his teeth upon the missionary's boots, which had not been removed. He gave orders that no more white men were to be killed and eaten. It is a fact that from that date no more white men were so treated, although many Fijians ate their countrymen for a couple of years after 1868. [The last cannibal feast was held in 1895 or thereabout.]

All in mourning for a young chief accidentally killed by a stone flung at a wild cat. The male inhabitants absent, fishing for food for the funeral ceremonies. Entered the lower village. All houses empty. Arrived at the Bure. Well built, large and roomy. At 8 p.m. the chief and a large party entered and received us hospitably.

Sunday, 7th.

Slept badly. Bure very close. Weather much warmer than the station we had left. Bathed in a clear stream below the village, and upon returning, found that a messenger had arrived from Namosi, stating that a man-o'-war had arrived at Levuka.

Great doubt as to the real state of the case, as the messenger brought no letter of testimony or proofs of any kind.

Slept in the middle of the day, and after lunch made preparations to ascend the hill to the larger village. A stiff climb of about $1\frac{1}{2}$ hours brought us to it, and proceeding some miles beyond it we arrived at a large and populous one called Numbutautau.

Returned to Tholo-Vatu, and found chief very attentive and hospitable. Regarded with great astonishment by a numerous population. Entered the Bure, and after dinner witnessed a dance in honour of the dead chief, and gifts of tappa to the defunct.

Had some fireworks in the evening. Retired to rest. Slept well. Night cool.

Monday, 8th.

Rose early and ascended the hill. Had a fine view from the top. Extraordinary basaltic stones. Ba and the ranges of Naloto visible. Very rugged table mountain parallel to the sea. Descended. Breakfasted. Great difficulty in adjusting the loads. Chief assisted and threatened the sluggards. At last started. Very fine view on all sides. Easy marching.

Arrived at a village called Vatu-Koro, but passed through it. After some difficulty forced the chief on. Bathed in the stream below. Lunched, and again ascended a steep hill, Tuloa being S.S.E. Naloto still visible. Descended into a small ravine at nightfall. Made a large fire, and passed the night.

Tuesday, 9th.

Chilly night. Rose early and started immediately to climb the hills, and pushed upwards, travelling until we reached the summit. Descended into a ravine and halted. Prepared for breakfast. Rumour arrived of a series of successes on the coast by the Bau people.* Terror of our guide, the chief.

Started after breakfast, and arrived on the top of a hill commanding a fine prospect. Here we were joined by some people from a village lower down, bringing yams for the coolie porters' breakfast, who terrified our guide into withdrawing from his engagement. Various accounts of the destruction wrought upon the coast by the Bau people. He retired after much deliberation, and gave us into the charge of the chief who had approached us from a neighbouring village, and who consented to conduct us. Passed through dense jungle and by many little clearings and villages, and found the natives hiding their effects from the Bau men. Our new conductor makes a long statement about a woman killed and eaten by the Bau people.

The old conductor decided to retire at length. New conductor changed

* A kingdom upon the east coast, almost opposite Ovalau island. The king was named Cakobau (pronounced Thakombau), who was noted for his fierce cannibalism.

his mind as well, and left us to go on alone. Arrived at a village in which there were only four inhabitants, who guided us as far as the next one. Easy walking. Encamp for the night in the open, beside a stream. Only a little food. No rest, on account of the mosquitos.

Wednesday, 10th.

Rose early and started. Road easy. Landscape heavily afforested. Proceeded in the direction of Tavua, and halted for breakfast at a village which had been burnt by the Bau men. Surprised a pig, which a coolie killed with a stone. Obtained some bananas also, as our people had been without food. Started again over level country. Passed deserted villages and at length met some labourers in a field,† who were astonished at our appearance. They willingly volunteered to carry our baggage, and after a march of about 15 miles (they, in the meantime, having acquainted every one *en route* with the wonders of our journey) we arrived at Tavua. Old chief absent. Learn that the man-o'-war is waiting at Bau. J. expressed great anxiety to start. Yams for tiffin, together with a Fijian pudding, a present from the chief.

Later in the evening great difficulty in persuading him to lend us a canoe. At length induced him by threats, and we started for Rakiraki.

Tedious journey through the river mouth, as the canoe frequently grounded upon sand-bars. When we got outside, between the reef and the coast, we found the tide falling, and, seeing a hut upon the shore, made for it just as the sun set. Found owners were employed in the beche-de-mer trade. Slept in their hut, and our coolies in the drying hut.

Thursday, 11th.

Rose at daybreak. Morning bright and fresh. Slept well. Waded out to our canoe, and set off again for Rakiraki. Mounted sail. Canoe leaked like a basket. Wind right ahead. Carried on until the retiring tide left us nearly high and dry. Finally ran upon the reef.

Crew went ashore to get vegetables. Our coolies caught a small pig and prepared it for tiffin. We were all very hungry, not having eaten anything all day. Waited some time for the crew and longer for the roast pork.

When the tide rose we again set out. Put in at a village, the chief of which delayed us for some time. Learned that Ratu Epeli ‡ is at Navatu. Poled along the coast for two hours, and arrived, after many stoppages, at Navatu.

Received kindly by Ratu Epeli and the Teacher, who offered us rooms in his house. Large assembly of chiefs. Authentic information concerning man-o'-war which is still at Bau, and has been in Fiji for over a fortnight. The Ratu agreed to take us over to Nanono, where we have to wait until the Trade wind permits us to return to Levuka. Retired to rest early.

Friday, 12th.

Rose and walked about the place. Picturesque rock. Enormous quantities of cotton covering the country side. Breakfasted off turtle and arranged for Nananu. Wind strong and blowing from east. Great difficulty in getting the canoes ready. When they did arrive the tide had fallen! Journey postponed until the next morning.

Endeavoured to pass the rest of the day. Great quantities of fish brought in by the warriors' canoes. Reported terror of the Vutia people at the appear-

* *I.e.* upon a plantation.

† Ratu Abel; the Vunivalu of Bau, *i.e.* the son and heir of King Cakobau.

ance of the warship. Conscious of their evil deeds, no doubt. Clubs reported as having been taken in battle at Ba. Arrangements for the night satisfactory.

Saturday, 13th.

Rose and bathed in a creek near the town. Breakfasted. Canoes all ready. Started for Nananu. Poled briskly out of the bay. Wind fell a little. Saw a schooner in the offing. Hailed her. Bound for Levuka. Decided to board her.

NOTES ON BANANAL AND THE ARAGUAYA VALLEY

R. B. Clark, B.Sc.

DURING the latter part of 1922 we made the journey from Rio de Janeiro to Pará by way of Goyaz and the Araguaya River, crossing the famous Bananal Island *en route*. At that time railhead was some 70 leagues from Goyaz Capital, and this distance was covered in two days by motor. Travelling by car along such roads as exist in this region is desirable only as an alternative to spending ten days on a mule. This isolated state capital now has some 15,000 inhabitants, and one wonders why such a site was ever chosen for a town. It is surrounded almost entirely by high hills, and only a short distance from the divide between the Plate and Amazon systems. Though the town is about 1500 feet above sea the climate is excessively hot, due to the surrounding hills. The site was no doubt chosen because of the gold deposits in the immediate neighbourhood, and even now one hears from the inhabitants stories of fabulous wealth awaiting the advent of modern mining machinery.

Our journey from Goyaz to the Araguaya at Leopoldina was made in six days on mule-back through a lonely and almost uninhabited country, where travelling was anything but pleasant. The motor road now nearing completion will not only bring the capital of Goyaz within a day of the Araguaya, but will, when the railway reaches the capital, bring Rio de Janeiro and São Paulo within six days of this great river.

At Leopoldina—an unattractive collection of mud huts—we hired a dug-out and started on our long journey of 1000 miles, travelling very light, and carrying only enough mandioc flour, rice, beans, and raw sugar for our journey and for trade with the Carajá Indians. For this we also took a stock of beads, mirrors, and calico, with which we were able to secure a good collection of ornaments and weapons. These people we found very friendly and hospitable, and always ready to trade or act as guides. We spent many a night as guests in their villages, and were conscious of absolute security and goodwill. But we were careful to avoid the left bank of the river in the neighbourhood of the Crystallino and Rio das Mortes, the abode of the fierce and much-dreaded Chavantes.

Just below the mouth of the Rio das Mortes, at the Carajá village of Santa Isabel, we decided to cross the island of Bananal and visit the Javahé Indians who live in the interior in the neighbourhood of the Lesser Arm.

We had previously entered the island at the mouth of the recently discovered river São Luiz, and had made our way up this river to discover the topography of the island and its suitability for farming and cattle-breeding. A third trip inland was made at a point known as Furo do Pedra, just below the mouth of the Rio Tapirapé. From what we saw on all three occasions, and from what we learned of the Indians, we are convinced that Bananal island is flat, and largely flooded in the wet season. The southern end of the island is thickly forested, and in all probability some sections in the north; but for the most part it is open campo, or prairie. From the vegetation and nature of the ground one could readily see that during the flood season large areas were inundated, while perhaps equally large areas escape the flood. The Carajas at Santa Isabel informed us that when the river is high they are able to visit the Javahés by canoe across the island.

In 1921 a Brazilian cattle-owner drove about eighty head of cattle from Furo do Pedra through the island and down to the civilized section of Southern Goyaz, and reported a greater number of head on leaving the island than he owned on entering. This is a good advertisement for Bananal, for long treks are as a rule very hard on cattle, and a net loss is almost invariably the result.

Many of the long and narrow "lakes" so frequently encountered on the island were found to be running water, though the current was usually extremely sluggish. We finally came to the conclusion that these bodies of water are of three kinds. First, those that are really still, which vary in area according to the season of the year and receive their supply from rain. They are winding and narrow, and have the appearance of rivers. Secondly, there are those which in every other way resemble the first, but which have a very slow current.

Thirdly, there are the numerous "lagos," or arms of the river which occur all along the course of the Upper Araguaya and which when encountered far in on the island have the appearance of lakes, but which are really "broads" or arms of the main stream.

In conversation a few weeks later with the Dominican Bishop of Conceição, who had been visiting the Javahé Indians on Bananal very shortly before, we learned that his party had discovered "a large but sluggish river flowing into the Lesser Arm of the Araguaya," which in all probability was the same body of water we had explored further in on the island.

At Furo do Pedra, a little below the mouth of the Tapirapé river, we climbed to the summit of one of a small range of hills that comes to the very edge of the river and runs in a north-easterly direction at an

angle of about 45° with the main course of the Araguaya. We found the first of these hills to be almost void of vegetation towards the top and affording a magnificent view of the majestic river and surrounding country. The remainder of this small range, never more than 350 to 400 feet above the river-level, was thickly covered with forest and rich in valuable woods. From the summit which we ascended we could see no sign of any other high ground on Bananal, and we believe that from this point we could easily see across the island, which could hardly be more than 20 miles wide at that point. On the Pará side of the river hills could be seen in the distance.

Though Bananal is inhabited only by the Indians, and is placed between the territories of two savage and hostile tribes, yet it is rarely attractive. The breezy, open pasture-lands where deer abound; the winding lakes with their picturesque banks and abundance of wild duck and birds of gorgeous plumage; the small and widely scattered villages of the lovable Indians, combine to make Bananal a most fascinating island. No one who has passed a night on the edge of one of its lakes, with friendly savages sitting round their camp fires chattering in their weird dialect, who has by day seen the deer dart away across the prairie, and watched the wild duck and herons feed by the water's edge, and the fish leap high into the air for mere sport, no one who has experienced the charm, can fail to have a longing for return.

We found the Javahé Indians very friendly, and in every respect like the Carajás. There is no doubt that they are one and the same people, split in the past by some quarrel. They had never seen a white man before, and were on the point of abandoning the village on our approach, but after a satisfactory explanation by our Carajá guides, they gladly entertained us for a day and a night. They fed us, traded with us, danced for us, and even organized a series of wrestling bouts for our entertainment. Each warrior was painted red and wore a fighting belt and cap, cleverly made from parrot and macau feathers. The bouts of wrestling were most interesting, and as a rule were between the Javahés and our Carajás. Like the Carajás, the men go naked, and the women wear a loin-cloth.

Were the whole Araguaya and the Lower Tocantins a broad smooth-flowing river, as it is for the first half of its course, conditions would not be what they actually are on Bananal island to-day. Were there no rapids on these rivers to cut off this great valley from the outer world, its wealth of grazing lands, of rubber and mineral deposits would long ere this have been invaded by fortune-hunters. For truly the region of the Araguaya is a region of immense possibilities.

The rapids of the Araguaya are, in the flood season, not at all formidable, and could be made safe for launches of shallow draft and great power. In the dry season lack of water will always be a difficulty. We shot the Araguaya Rapids in our canoe, and learned enough to con-

vince us that a small annual grant—which since our visit we understand has been voted by Congress—would be sufficient to keep the channel clear and make navigation possible.

The rapids of the Lower Tocantins, below Marabá, are more dangerous; but even these with comparative ease could be made navigable for suitable launches. As a contrast to what was described by Captain Bullock of his ascent of the Itaboca Rapids, we descended the worst section, of just 4 miles, in exactly ten minutes! We agree that the maps of this river by the French explorer, Coudreu, some thirty years ago, are as accurate as can be obtained.

It appears to us that the clearing of these mighty twin rivers and the charting of a course on the Upper Araguaya would result in great benefit to Brazil. Not only would the rich valley of the Araguaya be opened to exploitation and development, but the very centre of the South American Continent and the great interior state of Matto Grosso would be opened to the markets of the world.

The Rio das Mortes is navigable for shallow-draft boats to within 200 miles of Cuyabá, the most central town of the continent. This river, together with the Araguaya and Lower Tocantins, forms a natural waterway for commerce, and outlet to the Atlantic. At present this central section of the continent finds outlets by the Paraguay river, and the railways of Southern Brazil. The great advantages of the Rio-das-Mortes–Araguaya–Tocantins route are obvious. Waterways are cheaper than railways, and the products would reach the Atlantic at Pará, which is much nearer the markets of Europe and North America than are the distant ports of Rio de Janeiro and Buenos Aires.

Over and beyond this there is the military value of such a strategically situated waterway for the movement of troops from south to north by an inland route. This was one of the main contentions of President Conto de Magalães when pleading for the opening up of the Araguaya. Only 40 leagues separate the extremes of launch navigation, in the wet season, on the rivers Araguaya and Taquary, a tributary of the great Paraguay river; and the linking of these two great systems, thus forming an almost continuous waterway between Buenos Aires and Pará through the heart of the continent might easily become an accomplished fact.

ROUTE OF THE RAILWAY FROM TABORA TO LAKE TANGANYIKA

Map follows p. 432.

AT the end of the present number we give a map, on the scale of 1/500,000, of the route actually taken by the Central Railway of the Tanganyika Territory constructed by the Germans from Tabora to the Lake. The course of the railway in this section is shown quite

erroneously in most maps, being that originally proposed after the first preliminary survey, whereas in fact the line as eventually made deviated very considerably from the original trace. We are indebted to Mr. C. Gillman, whose account of an ascent of Mt. Kilimanjaro appeared in the *Journal* for January 1923, for the copy of a plan of the railway on the scale of 1/300,000 compiled by the contractors for the railway (Philipp Holzmann & Co.) on the basis of the original survey on the scale of 1/10,000. Our map has been reduced from this, with the addition of a certain number of altitudes from other sources, as but few were shown on the German plan. It is to be supposed that a section of the country along the line of the railway must have been prepared by the contractors, but unfortunately no such section accompanies the plan sent by Mr. Gillman. This contains however a good deal of topographical detail and forms a useful addition to the cartography of this part of the Territory.

THE NEW MAP OF FRANCE

La Nouvelle Carte de France. Paris: Service Géographique. de l'Armée. 1923. 9½ × 6½, pp. 124. *Maps.* 1*s.* 8*d.*

ODDLY enough France, so forward in the early days of geodesy and topography, is really badly mapped compared with her neighbours. As a nation we have had a unique opportunity of judging of that fact, and we cannot but endorse the statements to that effect of the *Service Géographique* in the publication under review, and of Emm. de Martonne in *Annales de Géographie*, January 1924. French soldiers, engineers, and scientists have repeatedly urged the politicians to take action, and this booklet, summing up the arguments of a century, presents a strong case for a new general map and offers a cheap and workable programme for its execution.

To the average Englishman the official maps of any country come under the heading "Ordnance."* It is still quite common to receive requests for the "Ordnance Maps" of France. To understand the position in France to-day, it is necessary first of all to realize that there is no French equivalent to the Ordnance Survey. There are cadastral plans of a sort, but in manuscript, and so out of date that railways are not to be found on them. There are no "opposite numbers" to our 1/2500 and 6 inch to 1 mile maps. There is no one department to undertake the national task of providing such maps as may be required for national ends. The Departments of State do much for themselves. In the words of Colonel Boissier (written in 1816, but still true), "it is only too common to see individual bodies and departments wasting the national resources in surveying the same area independently whereas one well managed and directed survey would satisfy all requirements." The *Service Géographique* is however in a position of some sort of responsibility, for National Committees which have sat from time to time have referred to it as the natural body to undertake the execution of a new National map, and it

* The word "Ordnance" has, of course, no mapping, or survey, significance, and belongs naturally and only to the Ordnance Survey of Great Britain as illustrative of its origin.

has produced and maintains the largest-scale universal map of France which exists at present—the Carte de l'État Major at 1/80,000.

This sense of responsibility is no doubt the primary reason for the publication of the book, but the *Service Géographique* and the French Army in general are also anxious to secure a map for national defence. The 1/80,000, a good map in its day, is no longer suitable for the purpose. Before active measures can be taken, however, funds must be forthcoming, and the public must be awakened to the advantages which would follow upon better mapping. The views of leading men are quoted *in extenso* in a chapter entitled "The General value of large-scale Surveys and of a new map of France." They deal with the very large sums of money wasted in partial and individual surveys for lack of a reliable map; with the claims of railway, canal, inland-water transport, and water-power engineers; with mountaineering and tourist traffic; with rural administration and agriculture; with geology; and with the education of the rising generation. Old and well-known truths all of them, but hard to impress upon harassed politicians and administrators because they look to the future rather than to the immediate present.

The claims of national defence are dealt with in a separate chapter. It is admitted that during the retreat to the Marne the 1/80,000 fulfilled its purpose. The imperious necessity for a larger-scale map, under more stable conditions —from the battle of the Aisne onwards—led to the general adoption of the 1/20,000 or 1/25,000 scales in all armies engaged on the western front, but it is stated that a "gridded" map of some smaller scale is also absolutely necessary for the conduct and organization of modern war, and must be available for issue to the troops during rapid movement. The 1/80,000 will not do for the purpose. It is too small and too inaccurate.

Although nominally dealing with the proposed 1/50,000, both of the last-mentioned chapters are clear in their arguments for two kinds of map. A medium scale—1/10,000 or 1/20,000, and a small scale—1/50,000. The latter is to be the national map, divorced from any special purpose, and aiming at portraying generally the physical features and the works of man, whilst the former is to be the reproduction to scale of the actual field work (or "minutes"), and is to be available for the scientist, engineer, and soldier.

The general programme asked for, then, is as follows:—

1. A new and complete survey of France—At 1/10,000 for areas of particular importance; at 1/20,000 elsewhere.
2. The publication of this survey at its original scale, but where the scale is 1/10,000 the corresponding map to be published in black only, and a reduction to 1/20,000 to be made also. Thus a universal 1/20,000 would result, and would be printed in three colours in important areas, in black only elsewhere.
3. The publication of a 1/50,000 derived from the above surveys.

Curiously enough this programme is exactly the same as was advocated more than a century ago by Laplace, and it has been repeated by successive committees or Commissions appointed by Parliament to discuss the proper scales. A *résumé* of these various committees and their findings is given in a historical summary. The *Service Géographique* is in full accord with the views expressed. The last Committee, in 1890, when the revision of the Cadastrals was advocated (in vain), expressed also a semi-official desire that the *Service Géographique* should, by experiment in the field and office, fit itself for the execution of a new general survey. The Minister for War took action accordingly, and the few elaborate and highly artistic sheets at 1/50,000

published before the war are the outcome. These maps, the result of some fifteen printings, were produced without radically disturbing the normal routine of the *Service Géographique*, and in consequence at a rate which would have required from 250 to 300 years to complete.*

There are several points of interest about this programme. The first question one asks oneself is, Why begin at 1/10,000? If a cadastral map is necessary, then the survey for it can be made the basis of all smaller maps. Apparently in France cadastral plans are considered necessary and are jealously guarded by the revenue authorities (*Bureau des Contributions Directes*) and by the respective communes. But they are, for the most part, absurdly out of date, and must some day be abandoned or re-made. A recent experiment in Germany would seem to indicate that cadastral plans at 1/5000 (about 12 inches to the mile) suffice for rural districts.

The second point is that of the triangulation. The grand triangulation of France, of about the same date and accuracy of observation as our own, is not yet systematically adjusted, and has suffered the loss of many stations. It too must some day be abandoned or repaired. The *Service Géographique* is definite in saying that the new map can, none the less, be made from it and from the resulting second and third orders. It is certainly possible, but it is clear that the perambulation, adjustment, and patching of this old triangulation cannot be done without additional labour and expense. There is much to do before the topographical surveyor can make simultaneous use of the triangulations of the "Ingéneurs-Géographes" of the *Service Géographique*, and of the French hydrographers.

The pre-war fortress "plan directeurs" (1/20,000) and 1/50,000 were made on the polyhedric projection so popular in Central Europe. By deciding upon this projection the rectangular sheets and Bonne projection of the 1/80,000 were abandoned in favour of a system which kept the East and West margins of each sheet true North and South. The advantage, which is described in this booklet as "illusory," of being able to join up sheets indefinitely was thus lost. The polyhedric is not however a suitable projection to use for modern warfare. The plotting of additional points and the calculation of range and bearing upon it are not easy. For these reasons it is now proposed to adopt the Lambert conical orthomorphic with two standard parallels (or shall we attribute it to Tissot? †), which was used in the War; but, in order to keep to the old sheet lines, each sheet is to be bounded by meridians and parallels. A grid is to be over-printed on a military edition, and the cutting lines of the grid, but not the grid itself, will be shown on the civil edition.

Here again there is room for difference of opinion. If the map user has a compass, and a diagram in the margin to show him the angle between magnetic north and his sheet lines, it is immaterial whether the latter are true north or not. If he has no compass it is still more immaterial. It is of course a pity when sheet lines diverge too far from true north. The map should be roughly setable to the points of the compass, but within fairly wide limits the matter is of small consequence. On the other hand, it is a nuisance to have the grid running at an angle to the sheet lines. As regards the universal use of the grid the Germans have decided to print grid lines upon all editions, and it would seem that French scientists and engineers would profit from a similar proceeding as much as did the soldier in the war. Modern Egyptian practice on this matter is worth attention.

* General Bourgeois in 1912.

† See *R.G.S. Journal*, **57**, No. 6, pp. 449–450, June 1921.

The general proposals are open, then, to criticism, but they are conservative, and will please the majority, to which end they are doubtless framed.

The design of the maps which it is proposed to make is effective, cheap, and pleasant. The 1/10,000 (in black) is drawn for reduction. The names and numbers are therefore rather big. It is difficult to judge of the effect of the writing from the small sample published. A successful effort has evidently been made to combine clearness and ease of execution. All hair line has been abolished, and as far as the sample goes there are no names in capitals. Names, on the average, are more than twice as large as on our 6-inch, and yet there is not the contrast nor the emphasis secured by the Ordnance Survey. Bench-marks are given with their heights in heavy type, but it is difficult to place the actual spot or bench-mark to which the height refers. Contours are at every $2\frac{1}{2}$ metres. At every 25 metres is a "reinforced" or heavy chain dotted contour; the 5-metre contours are in fine chain dotted, and the $2\frac{1}{2}$-metres in light peck. Road classification is efficiently done by the style and heaviness of its border lines. The first point to strike an English eye is the tree symbol, which, for deciduous, is an irregular sort of circle, supposed to be the tree in plan, but for the non-deciduous is like a Noah's-Ark tree lying on its side. The non-deciduous sign is simple and easy to understand, if not striking, and the deciduous sign clears the map and leaves more space for names than our own. Whether it would be preferred by those accustomed to the very descriptive signs of the Ordnance Survey is another matter.

The 1/20,000 in three colours (reserved for areas of particular scientific, industrial, or military importance) should be a popular and useful map. It is very like our own military edition at 1/20,000 except for the lettering, which is in the same style as that of the 1/10,000. The contours are at 5-metre interval with every fifth emphasized. The blue "water-lining" of the streams is heavy but pleasant.

As Italy is to survey and to print certain of her larger-scale maps at the same scale, there will be the three 1/20,000 maps of Belgium, France, and Italy fronting the 1/25,000 of Holland, Germany, and Switzerland.

A striking feature of the French proposals is that the lettering does not differentiate between physical features and the abodes of men. In all other cases a differentiation is made, although in the Dutch and Swiss maps it is secured by employing sloping lettering for the former and upright of the same character for the latter. Loss of emphasis and clearness is unavoidable in consequence, but there can be little doubt that money and time will be saved.

The *pièce de resistance* is the 1/50,000. This is a popular scale for a general topographical map. The central Powers (Germany and Austria) are beginning to turn to it in preference to their 1/100,000 and 1/75,000 respectively. Italy will probably follow suit, and Spain is publishing on it. Curiously enough, however, in Egypt, the reverse process is taking place and the 1/50,000 is not being kept up to date.

As before mentioned, the first sheets of the French 1/50,000 were produced by the *Service Géographique* as an experimental measure. There was no idea of completing the map for the whole of France until national measures had been taken to secure the finances. These first sheets were most elaborate and, although they provided a really artistic model, were by no means simple or cheap to produce. The Versailles sheet is described in 'Maps and Survey'; and a portion of the Toulon sheet is given as illustration in 'The Text-Book

of Topographical Surveying.' No more need be said here, therefore. In commenting on this preliminary effort the *Service Géographique* says: "Generally speaking, experience shows that a search after perfection in a multiplicity of detail and contour is apt to prove illusory. A general utility map cannot serve particular ends. It cannot take the place of special purpose map, diagram, guide, sketch, or table of statistics." On the other hand, an attempt to produce such a map necessitates particularly fine penmanship, an extravagant paper, and frequent revision.

It is recommended, therefore, that the new map should be one of only five printings—that red should be abandoned, and that lettering should be simple, upright in practically all cases, and in few classes. "The artist in cartography will be the only one to mourn the bold, fine, and diverse lettering of the old style." We cannot quite agree. If the situation makes economy the paramount factor no doubt descriptive lettering must go, but one can but regret it. It is in the industrial districts of the north that this simplified writing will be employed only with difficulty. The comparatively rich and diverse alphabets employed by English and mid-European cartographers probably owe some of their fineness to the lingering tradition of the copper engraver, but they also cater for more highly developed regions than it would seem possible to deal with adequately in the style advocated. It is also to be observed that while arguments in favour of a new survey are advanced in the interest of Geology, no distinctive lettering is proposed for objects of archæological interest.

The five colours are to be used as follows:

1. Black—Planimetry (detail) including towns, villages, houses, etc., roads, administrative boundaries, trees, hedges, rocks, names (other than water), population statistics, and heights.
2. Green—A solid for woods, peck or ruling for cultivation on the same plate.
3. Blue—All water (in water lining, not solid) and under-water contours.
4. Contours in brown.
5. Hill shading also in brown but on a different plate. The military edition will omit plates 2 and 5.

A few points deserve notice. In the first place many of us will concur in putting towns and villages in black. Red is a violent colour which attracts more attention than a village may be held to deserve. Black is a neater and just as adequate a colour for the purpose. Secondly, the road classification is ample except for the one point of "surface." The various classes are quite distinct at a glance. On the other hand, if frequent editions are made it is a help to be able to show up good, as opposed to bad, surface, a matter which is not always "according to plan."

Woods are well rendered with the black tree sign on a faint though quite adequate green—and when the green is omitted the wood still remains clear enough if not so pleasant. But the omission of the green plate (as of the hill shading) in the military edition would certainly not be popular with our own airmen. The blue is bold—the actual lines of the water lining even coarse, but the effect is good. Again most map makers will concur. The contours at 10-metre interval are good, although the numbering of them and the identification of the spots to which heights refer should be made more of.

The hill shading is a moot point. Prof. Martonne in *Annales de Géographie* is frankly hostile. Therein most of those who can picture a landscape from its contours and its drainage will concur. Hill shading is not susceptible

of precision, and is suitable for large rather than for small scales. On the other hand there are many, even eminent, men who do not seem ever to have grasped the significance of a contour. Such do profit from a broad grasp of the physical features, and form so numerous a class that we think the proposal a wise one. In this connection the addition of the old "hill engraved" plates of the Ordnance Survey on some of the sheets of the Tourist edition has much to recommend it. Layers are better, perhaps, but imply additional printing. Whether the old plates of the 1/80,000 are sufficiently good is of course another question.

Counting in the pre-war 1/50,000 sheets (50) and the provisional edition of Alsace Lorraine (33) (made in accordance with the proposals under review), one-thirteenth part of France has now been completed on this scale. 1050 sheets are wanted in all.

In discussing the technical aspect of the work on the ground, it is pointed out that the existing survey staff of the *Service Géographique* must be expanded from its present numbers (about 70 in 1923) to 436 (including 10 "revisers"). Private firms (such as *La Société Française de Stéréotopographie* which uses a stereoautograph) would be asked to take part in mapping certain areas, under special circumstances. Air photographs would be employed also, and in discussing the cost of photography it is stated that with military machines nothing but the actual cost of photographic material should be debited against the map.

An admirable summary of the present position and of the proposals is given at the close. The final *résumé* is as follows:

> The programme would be completed in twenty years. Each year 50 sheets of the 1/50,000 and the 200 corresponding sheets of the 1/20,000 would appear.
>
> Reproductions of the surveys of the 1/10,000 would be made. The technical staff would be 436 field hands.
>
> The annual bill would be 3½ million francs.

From this it would appear that the cost of the whole programme would be something of the order of £5 a square mile: a cheap price to pay for a survey at these scales and the production of the various maps.

In the interests of Geography, for the sake of our French friends, and for our own pleasure when we revisit the pleasant country-sides of France, we hope the programme may be carried out. Whether or no that may be decided upon, no case could be put better, more temperately, or more convincingly than it has been by the *Service Géographique* in *La Nouvelle Carte de France.* H. S. L. W.

REVIEWS

EUROPE

Unknown Surrey.— Donald Maxwell. London: John Lane, Ltd. 1924. 8½ × 7, pp. xii. + 210. *Illustrations.* 15*s. net.*

WRITERS on Surrey owe a considerable debt to William Cobbett. Few of them, at least, can resist the temptation of quoting frequently from him. Mr. Maxwell is no exception, though he does not always agree with him. Cobbett disliked heartily the fir trees and heaths so prominent in Surrey landscapes which must appeal strongly to an artist. Among Surrey men, Mr. Maxwell's favourite seems to be the more sedate John Evelyn. Most readers will regret

with him that Evelyn's plan to combat the London "smoak" nuisance by planting large areas with sweetbriar, woodbine, jessamine, and other sweet-smelling plants was not essayed, even though it had failed in its immediate purpose. Were it not for such incidental passages, particularly those fiery outbursts of Cobbett, it must be confessed that the book, with its haphazard arrangement, would be somewhat dull reading, and it lacks the more sustained interest of Mr. Maxwell's 'Unknown Sussex.' The illustrations, which are, after all, the reason for the book's appearance, are very well done, and have a distinction of their own.

The Saxon Shore.— Jessie Mothersole. London: John Lane. 1924. $7\frac{1}{2} \times 5\frac{1}{2}$, pp. xv. + 272. *Sketch-maps and Illustrations.* 8*s.* 6*d. net.*

This is a very pleasant book: there is not a dull page in it, so industrious and enthusiastic is the writer and artist. She has wandered the whole length of the Saxon shore, from Brancaster on the Wash to Portchester, has seen with the discerning eye of a painter, and sifted the information to be gleaned from historians and archæologists, without neglecting the human side. Her little adventures by the way provide a rich fund of anecdote. "The general reader," whoever he may be, should be flattered by this offering, as well as ninety-nine per cent. of serious students, while even the remaining one who thinks he knows all that may be known on this fascinating theme will respond to the charm of Miss Mothersole's narrative. The illustrations in colour, monochrome, and line are plentiful and helpful. By the "Saxon shore" the writer means, of course, the British side, not the Gallic, about which, indeed, not enough is known to make a separate book. Among books consulted is not mentioned a copious set of notes by Hugh Lanaway, of the Sussex Archæological Society. Although not given in the *Notitia*, Walton is included among the forts, making the number ten, and for this there is the authority of Haverfield. To keep it right up to date, the writer must have added matter to the moment of going to press, as there appears a new tile stamp, *Classis Brit.*, found at Folkestone only last April, and the fine gold medallion of Constantius Chlorus found near Arras in September 1923. Two little slips may be noted for a second edition: p. 140, χαίνος λιμὴν for καίνος, and p. 31, Princeps Juventitis for Juventutis. S. E. W.

Regional Architecture of the West of England.— A. E. Richardson and C. Lovett Gill. London: Ernest Benn, Ltd. 1924. $11\frac{1}{2} \times 8\frac{1}{2}$. *Illustrations.* 45*s. net.*

It is an encouraging sign of the spread of geographical ideas that a book should be published on regional architecture in England, written by two eminent architects and magnificently illustrated. The subject has received little previous attention, and probably no better choice of a type area could be made than that of Devon and Cornwall. Prof. Richardson and Mr. Lovett Gill have described the architecture, other than ecclesiastic, of these two counties from the middle of the sixteenth century to Victorian times, and demonstrated several lines of geographical influence. The foundation of a regional architecture is, of course, the nature of the materials available locally. In the area dealt with the more important of these are granite and slate. Granite suggests a sturdy dignity, but in Cornwall and Devon it is difficult to obtain granite that will exclude moisture. Many of the buildings have, therefore, a weatherproof casing of slate shingling. This slate-hanging of the walls is thoroughly characteristic of the region, and excellent photographs of examples in Exeter, Ashburton and other towns are given. In other parts of

Devon the thick soils of an unglaciated region lead to the use of cob for building, and a long low type of farmhouse is evolved.

Several foreign influences affected the architecture at various times, but the styles were always, to some extent, modified by local feeling and workmanship. The bulk of the trade of the Exeter district was with Holland, and Dutch engineers were employed to render the river navigable. Many of the houses of Exeter and Topsham are typically Dutch, and in some cases rubbed bricks were specially imported. The successive fashions in domestic architecture found their way from London to Land's End, and two interesting points are brought out: the various styles, such as the stucco of Nash and his period, are traced along the great west road and the modifications brought about by local tradition are noticed. Such fashions naturally affected the "country seats" of noblemen and the houses whose owners were familiar with London more than those of the humbler folk, who regarded the greater part of England as a foreign country. St. Ives is a typical village of granite cottages, many of which are later in date than such brick houses as the "Retreat," aptly compared by the authors to a red-coated Hanoverian soldier among the fishermen.

The photographs and sketches, over two hundred in number, are all placed appropriately in the text, an advantage somewhat discounted by the consequent use throughout of a heavily loaded paper, making the book difficult to handle. The latter part of the book betrays evidence of hasty writing in the style and grammar and a few slips; geologists will be amazed to find the Totternhoe stone, rightly compared with that of Beer, described as the "old red sandstone of Bedfordshire," and Cookworthy's discovery of china-clay should be dated 1753, not 1733. There is a useful index of illustrations as well as a general index. In the Introduction the authors suggest that five architectural regions should be recognized in England; we hope that they and Messrs. Benn will give us similar volumes on the remaining four.

C. N. B.

ASIA

Sport and Service in Assam and Elsewhere.— Lieut.-Col. Alban Wilson, D.S.O. London: Hutchinson & Co. 1924. 9½ × 6, pp. xv. + 320. *Illustrations.* 18*s. net.*

Colonel Alban Wilson served for twenty-seven years in the 1st Battalion of the 8th Gurkha Rifles, mostly on the Assam frontier. During that time he obviously made the most of his opportunities for sport, and every page of this genial, discursive, and easily written book shows him to be the true hunter, and above all the true fisherman. His most unpleasant adventure was an encounter with a rogue elephant which charged him, and he describes how "the thick, heavy grass, which was at least 8 feet high, pushed aside by his body as he passed, forced me backwards," and declares that he has "never been in such a funk either before or since." He gives an interesting account (which might well have been elaborated) of the Abor expedition of 1894, and has much of interest to say of the Nagas and other frontier tribes, while his book is most eloquent testimony to the splendid spirit of his Gurkhas. "There is not one," he writes, "no matter how queer a character he may have been, of whom I do not retain some pleasant recollection." The book is admirably produced and the photographs are excellent.

O. R.

Sturm über Asien: Erlebnisse eines diplomatischen Geheimagenten herausgegeben von W. Filchner.— Berlin: Neufeld & Henius. 1924. 9 × 6, pp. viii. + 311. *Sketch-maps and Illustrations.*

This is a work that no one interested in the politics of Central Asia should miss. At a first reading it would appear to contain little of purely geographical interest, but closer study and reflection convey an important lesson in vivid fashion. The Asia of which Filchner gives us a series of intriguing pictures, reminiscent of the William le Queux style, is far removed from the Asia of the Arab, Persian, or inhabitant of the Ganges valley, or even that of the more virile Pathan or Punjabi. In a word, it is the real inner Asia of Mongolia and Tibet, with its appanages in China, Manchuria, Japan, Siam, Nepal, and Cambodia; that Asia which wears its heart on its sleeve, laughs with the traveller from the West, but ever keeps an impenetrable mental wall between its thoughts and his.

All through the author's stories, a series of episodes in the life of one Zerempil, a Buriat subject of Russia, runs the theme of Russia's generations of striving against India, still continued. In the centre of the northern face of what the author graphically calls the "glacis of the fortress of India," lie Urga and Kumbum. The latter is the birthplace of Tsongkapa and the scene of most of Zerempil's experiences. Here in the "monastery of the thousand pictures" his activities centred whilst his patron and preceptor Aguan Dorji (the "Dorjieff" of the press) intrigued for Russia before Sir Francis Younghusband's mission. The stories take us on to the fighting on the road to Lhasa, viewed from the other side, and China's subsequent efforts to recapture her "Lost Dominion," varied with the influences of Anglo-Japanese politics on the fate of Tibet. Perhaps the best chapter in the book is the vivid description of the bloody siege and sack of the monastery by the troops of General Chao, the capable and energetic leader that China so often produces in a crisis, and of whom she was deprived by a stroke of ill luck when most she needed him.

The Tibetan struggle for independence from China occupies a large share in Zerempil's life-history, but not so great that it is more than an episode in his devotion to Russia. Perhaps it is not really Russia that claimed his worship so much as the spirit of the great plain, the "middle land" which holds Kiev and Moscow as well as Urga, Kumbum and Chamdo, Kazan, Irkutsk and Urumtsi.

The author shows, though he does not put it in words, how this spirit strives, through the centuries, against the seaboard peoples that hem it in. Every millennium sees wave after wave sweeping outwards from the great plateau and the great plains towards the seas that are the bases of "Nordic" and "Mediterranean" existence.

The scope of the book is shown by the characters who flit through its chapters. Colonel Orlov opposes Sir Francis Younghusband; Dorji and Bogdanovich jostle Nain Singh and "A-K." General Pereira shares his laurels with Colonel Kozlov, whilst Von Ungern-Sternberg, Vatsétis, Tobden-Lama, Amanullah Khan, Tsongkapa and Trotski, all find a place in its pages. The author takes us as confidently to Sang-pi-Ling, to Amdo, or to the Alai as he might to Charlottenburg or the Wann-see, and discusses happenings on the slopes of the Nan-Shan or the Tang La as if he were describing the Ruhr.

Perhaps the dozen or so rather inappropriate photographs of Ladakh constitute a slight blemish on an excellent book, which is quite reasonably

free from anti-British prejudice. There is a curious mistake on page 9, where the author places the Cossack fort of Gulcha to the north of the village, whereas it stands uncompromisingly to its south. His description of the Bordebe–Murghabi route smacks a little of the second-hand, whilst the Cossack escort at Qizil Rabat, "William Jones" at Peshawar, and the extracts from the *Times* on page 32 are evidently fictitious. These are small defects, however, in a book which gives a collation, to be found probably nowhere else in similar compass, of the history of the inner Mongoloid countries from 1899 to the autumn of 1923.

The maps are appropriate and good, but it is a pity that they do not open clear of the text. L. V. S. B.

Map of Sarawak.— Compiled by **Charles Hose, D.Sc., F.R.C.I.**, from his own compass traverses combined with all other available cartographic material. 1923. Scale 1:500,000 or 2/M (1 inch to 7·89 stat. miles). 4 sheets, each 23 by 32 inches. *Price £1 1s.; mounted, £1 12s. 6d.*

All interested in Borneo will be pleased to learn that Dr. Charles Hose has recently compiled and printed, at his own expense, what is doubtless the best general map of Sarawak that has hitherto appeared.

From his long residence in that country, and his extended travels in the interior, accounts of which have been given in the publications of this Society, he is exceptionally well qualified to undertake such a task, especially as he is a good geographer and anthropologist. During his journeys he carried out careful compass traverses into parts that were then quite unknown, all of which he has replotted and utilized in the preparation of his map; while his knowledge of the natives has enabled him to locate the various tribes as has never been done before. With his own work he has carefully combined that of other surveyors and travellers.

Except for a small amount of triangulation in the neighbourhood of Kuching, practically the whole of the mapping depends upon more or less approximate compass traversing, with occasional astronomical determinations for latitude and longitude, and, as will be seen, there are still many areas that have so far not been mapped at all. Still, Dr. Hose has evidently made good use of such material as exists, and his map is a most praiseworthy enterprise, especially as it has been produced at considerable cost to himself.

Soundings around the coast are shown, and have been taken, together with the coastline, from the Admiralty charts. Petroleum deposits, wireless stations, lighthouses, and boundaries are all given, while in the south-east corner is a useful inset sketch-map of Borneo showing the general geological features, after Posewitz.

The map is in four sheets, printed in colours—water blue, hill shading brown, and tribal names in red. It is on the scale of 1/500,000, although this is not stated, only a scale of miles being given. It is to be had from Mr. S. Staveley Briggs, South African Agency, 9 and 10, Broad Street Avenue. E. A. R.

AFRICA

Big Game and Pygmies: Experiences of a Naturalist in Central African forests in quest of the Okapi.— Cuthbert Christie, M.B. With an Introductory Chapter by **Sir Harry Johnston, G.C.M.G.**, etc. London: Macmillan & Co., Ltd. 1924. $8\frac{3}{4} \times 5\frac{1}{2}$, pp. xxxi. + 325. *Illustrations and Map.* *21s. net.*

Though this book is intended to appeal to the naturalist rather than the pure geographer (for all but six of its thirty chapters deal with animal life),

there is much, especially the scenes and incidents in the Ituri forests, which will be of interest to all.

The main theme of the book is the determination of the character of human and animal life in equatorial Africa by the nature of its great sunless forests, which have influenced the form and nature of the pygmies and animals which dwell among them. With the steady destruction of these forests by axe, fire, and even elephants, the nature of the flora of equatorial Africa is changing from the high-treed, sunless forests to those lighter, more open ones, sometimes spoken of as "bush," and the change from life in shadow to life in sunlight is altering the character of both men and animals.

It is generally recognized that the fauna of the great forests of West, Central, and East Africa is specialized and different from that of North and South Africa. It includes that interesting and one-time legendary form, the Okapi, which the author was fortunate enough to hunt successfully and in very interesting pygmy company; that beautiful forest antelope, the Bongo; a huge and hideous pig, the "Forest Hog"; diminutive forms of the elephant, hippopotamus, and buffalo; and those giant apes, the gorilla and chimpanzee. Dr. Christy deals with most of these animals in his book, but selects the forest types of elephant, and especially the buffalo, to illustrate his theories on the effect of environment on form.

As one journeys north and south, away from the sombre equatorial forests, the typical small red buffalo which is found in them becomes, in the more sunlit open bush, darker coloured and bigger horned and bodied, till (in the south) the big black buffalo is met whose immense widespreading horns are among the hunter's finest trophies.

All naturalists are agreed that these two types of buffalo exist, but also admit a graduation of form between them, the effect of environment on their development. Dr. Christy differs from the majority in believing that these two groups of buffalo are so far differentiated as to constitute separate species and not different races of the one species. He elaborates this belief in the four chapters on buffalo, and the argument, if not entirely convincing, is certainly interesting.

On the other hand, while clearly differentiating between the forest and bush types of elephant, in the half-dozen chapters devoted to this animal, he does not admit the so-called dwarf elephant as a separate species, but merely regards it as the smallest of the forest elephants, some of which may almost attain the size of the bush type, yet retain the special character of the forest species.

There are several interesting chapters in the book devoted to the smaller forest mammals, birds and fishes, with notes on their collection and preservation. In the preface Sir Harry Johnston gives a short but enlightening description of the distribution and migration of the African fauna, which he closes with the fervent hope that the book may not attract the butcher type of sportsman to these wonderful equatorial forests.

The book is well illustrated and contains two maps on the distribution of the African equatorial forests and the African buffalo. J. C. B. S.

AMERICA

Glimpses of South America.— **F. A. Sherwood.** London: Leonard Parsons. 1922. $9\frac{1}{2} \times 6\frac{1}{2}$, pp. x. + 406. *Illustrations.* 18*s. net.*

This book treats of a journey which, since the opening of the Panama Canal, is becoming increasingly common: a trip from New York around the whole of the South American continent by steamer. These trips can be

arranged to offer the traveller the privilege of landing at places on the route, so as either to take the following boat or to vary the journey by railroad travel between ports. The grouping of the main capitals of the South American States on, or near, the coast-line, of course renders this procedure exceptionally easy. The author has little to tell, and any interest the book may have for the traveller is centred in the author's easy and discursive style of writing and in the numerous illustrations, though these latter are not of a very high order. The chief reflection which strikes one in reading the book is that it emphasizes the need of a genuinely authoritative guide to South America. So long as such guides are not published, or at least are not known to travellers, this style of book will probably find a certain public.

W. S. B.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

World Weather: including a Discussion of the Influence of the Variations of Solar Radiation on the Weather and of the Meteorology of the Sun.— Henry Helm Clayton. London: Macmillan & Co. 1924. 18*s*.

Dr. H. H. Clayton, Chief of the Forest Department of the Argentine Weather Service, needs no introduction among meteorologists. His writings on the relations between terrestrial weather and solar variations form a striking contribution to the subject, and his latest book on World Weather will be an inspiration to many workers.

The title of the book, 'World Weather,' is an ambitious one, and at first sight it appears that the author has not quite lived up to his title. Of the fourteen chapters in the book, the first nine chapters form an introductory treatment of general meteorology. Dr. Clayton displays considerable knowledge of the recent developments of meteorology in all its branches, frequent references being given to the work of Shaw, Dines, Taylor, Bjerknes, and others. These nine chapters are profusely illustrated, and contain a large amount of information not very readily accessible elsewhere.

Then there follows a chapter on sky colours, scintillation, aurora, etc. Here again Dr. Clayton quotes writings which are frequently passed over by English authors. For example, he quotes Exner's views on scintillation of stars, the phenomenon being ascribed to small waves in the atmosphere. This theory is borne out by astronomical observations, but meteorologists are apt to regard scintillation as an irregular and casual phenomenon.

The eleventh and twelfth chapters are much longer than the earlier ones, and deal with the subjects which Dr. Clayton has made so specially his own study, namely, the relation between the variations in solar radiation and the weather. The measurements of solar radiation which he uses are those of Abbot. Fig. 185 shows a graph of simultaneous observations at Calamor, Chile, and Mount Wilson, California. The differences amount in some cases to as much as $2\frac{1}{2}$ per cent. of the estimated solar constant, which is of the same order of magnitude as the total range of variation observed. One cannot help feeling that it is highly desirable that there should be a network of stations scattered over the globe, carrying out regular observations of solar radiation, so that any casual errors arising at one station might be eliminated by comparison with the records of other stations.

Clayton's main result appears to be that an excess of solar radiation (coinciding with sunspots) produces temperatures below normal. This result is difficult to accept on physical grounds, as it would normally be expected that increased solar radiation should produce increased temperatures on the Earth. The subject is admittedly complicated and difficult, and the author makes no

claim that a simple relation of universal validity can be put forward. In regard to the relation of sunspots and temperature, the present reviewer, in the course of a periodogram investigation of 100 years' records of Edinburgh temperatures, found that the most striking periodicity was one of about 11·2 years, in close agreement with the mean sunspot period, showing maximum temperature at the time of maximum sunspots.

In a chapter on Forecasting the Weather, the author gives, in addition to forecasting from synoptic charts, an account of an application of accurate measurements of solar radiation to forecasting. Some of the results obtained are very striking. The last chapter gives a brief account of the meteorology of the sun. There are three mathematical appendices dealing with formulæ for gradient wind, the method of correlation and harmonic analysis. These appendices are too short to be of value to the student.

The book can be recommended to all those "general readers" who, with some mental equipment in the way of appreciation of physical principles, wish to know in what directions meteorology is progressing. The expert meteorologist will regard the first nine chapters as introductory to the treatment of radiation, and will probably regret that Dr. Clayton did not concentrate on that aspect of the subject, to the exclusion of the earlier chapters. In any case, reading this book cannot fail to stimulate interest in an aspect of meteorology which has not received much attention at the hands of English meteorologists. D. B.

GENERAL

The Goal of Commerce.— G. G. Chisholm. Reprinted from the *Geographical Teacher*, vol. **12**, 1924, p. 333–342.

This address was very appropriately delivered as the Herbertson Memorial Lecture; since it is in essence a plea for the orientation of our efforts towards the aim of increasing human well-being by producing a better adjustment of man to his environment which was the keynote of Prof. Herbertson's teaching during his later years.* Dr. Chisholm sets out what he considers to be the Goal of Commerce as being reached when "the inhabitants of the Earth will be able to enjoy the greatest possible variety of commodities supplied at the least cost and with the greatest attainable stability of prices"; and he refers also to a remoter goal which involves the attainment of the optimum density of population in every region. This may be regarded as expressing in terms of material things conditions necessary for reaching the higher goal, "that they may have life, and have it more abundantly."

The two questions which at once arise in relation to Dr. Chisholm's "goal" are evidently (1) Is it desirable? and (2) Is it attainable? We will assume that all agree that it is desirable; and hence discussion is limited to the second question. First it may be noted that what he calls the remoter goal seems to be logically first in that it is a pre-requisite for the attainment of the first-stated goal. There is, and perhaps always will be, much difference of opinion as to what constitutes optimum density under any given conditions, as witness all discussion on over- and under-population. But Dr. Chisholm is surely right in referring it to terms of human well-being—let us say, "the standard of living of all the people—rather than to an economist's "largest returns per head." Well-being, which is real wealth, is not to be directly measured in terms of money or profits or mere totals of goods produced. The more immediate aim (? of applied science and commerce) is to reduce the

* See his incomplete posthumous paper "Regional Environment, Heredity and Consciousness," *G. T.*, Autumn, 1915, vol. **8**, pp. 147–153.

labour required to produce and distribute the necessaries of food and shelter, and so to increase the surplus available for higher needs. The author here rightly emphasizes the danger of relying on merely temporary advantages, such as the coal of this country, and regards Britain as being at present over-populous, a view which opens a long vista of discussions. He refers to the possible use of direct sun-heat as a factor in the future distribution of sources of mechanical power; but does not mention what seems another alternative to coal worthy of serious trial here, namely the utilization of the energy of the tides. If this can be done successfully, Britain's advantage of possessing vast stores of mechanical power will become a permanent one.

This brief paper illustrates very well Dr. Chisholm's combination of high ideals with careful attention to minute details. It raises many problems in the application of such idealism; but it is more likely to impress the thoughtful business man and the scientific worker than any eloquence of peroration only. We hope that he will be enabled to pursue his study of the means of reaching his goals much further in the near future. C. B. F.

Admiralty Manual of Navigation, 1922.— Commdr. F. N. Shearme, R.N., and Dr. W. M. Smart, M.A., D.Sc. London: H.M. Stationery Office. Vol. 1. 10 × 6, pp. viii + 407. *Illustrations, Diagrams, and Charts.* 8*s.* 6*d.*. Vol. 2. 10 × 6, pp. vii. + 289. *Diagrams.* 5*s.* 6*d.*

This work, which is issued by direction of the Lords Commissioners of the Admiralty, is designed to supersede the previous (one-volume) 'Admiralty Manual of Navigation, 1914,' as the standard work on navigational subjects in H.M. Fleet.

Except in its title and general outline, it bears but little relation to its predecessor, every portion of which has been recast and, to a large extent, re-written *de novo*. In addition, a great improvement has been effected by the division of the manual into two volumes, the first being of an elementary and practical character, while the second is more advanced, and deals with the more exclusively theoretical side of navigation and nautical astronomy.

As compared with other well-known text-books of the same subject, such as Raper, Norie, and Bowditch, both volumes, but more especially the first, have a curious and distinctively "official" character, due, of course, to their having been primarily designed for naval use. They are severely practical, and give little or no information as to the evolution of navigational methods, while they necessarily contain a certain amount of material which, although of great value to naval officers, is of little interest to the ordinary student of navigation. The extensive division and subdivision of the work into parts and chapters, too, while admirable as a means of cross-reference, becomes to some extent a defect when such references are employed as the only page-headings, and renders finding one's way about the volumes a matter of some little care. In vol. 2, moreover, there are no chapter headings, and the information is occasionally presented in a somewhat disjointed and promiscuous manner, as when, in chapter xvi., one passes in the course of consecutive paragraphs from a description of the Van Dyk process of reproduction to an analysis of the theory of sextant parallax. The indexes of both volumes might have been enlarged and reorganized with advantage.

Apart from these minor points, however, and considered as an authoritative presentment of the methods and appliances of modern navigation, the work is an admirable one. Within the limits of a short review it is, of course, impossible to give more than a very brief summary of its contents. Broadly speaking, vol. 1 contains all that the practical navigator can require to know

about the principles, methods, and instruments of navigation, while vol. 2 plays the part of comment upon vol. 1's text, and exhibits the complete theoretical basis upon which the practical instruction of vol. 1 is based : it also deals with more advanced and strictly professional subjects such as surveying and the navigational side of naval tactics. Jointly, the volumes form what is probably the best and most up-to-date treatise upon navigation extant in any language. Separately considered, vol. 1 constitutes a complete manual in itself, covering the whole ground—nautical astronomy, coastal navigation, navigational instruments, tides, meteorology, and magnetism ; while vol. 2 is more a series of essays upon various branches of the subject, amplifying the necessarily more restricted treatment accorded these in vol. 1.

The illustrations include a large number of diagrams and photographs, and three very useful loose charts (in vol. 1) : a large sheet showing the signs and abbreviations used on the Admiralty charts, a specimen chart, and a time-zone chart of the world.

The volumes are obtainable separately, and their extremely moderate price forms an additional, although unnecessary, recommendation.

R. T. G.

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EUROPE

The Hornbeam in England.

ALTHOUGH common in certain parts of England, the hornbeam (*Carpinus betulus*) is probably less generally known than any other British forest tree, and even botanists have not always been sure that it was to be counted indigenous to this country. A very complete study of its distribution, characteristics, and uses in England, given by Mr. Miller Christy in the *Journal of Ecology* for January 1924, is thus of some interest. That the tree is not more generally known and admired is probably due to the common practice of pollarding in order to use the branches for fuel, for which they are eminently adapted. If allowed to grow naturally it may even reach a height of 100 feet, and is considered by some to surpass the beech (with which it is sometimes confused) in beauty of form. Its distribution in Europe (shown by Mr. Christy in a sketch-map) is roughly from south-central France to the river Ural, and from southern Sweden to the Danube, while in the extreme south-east it is replaced by an allied species, *Carpinus orientalis*. It is thus essentially a tree of Central Europe, but it crosses the Strait of Dover to south-eastern England, and it is to this part of the country that its range in England is limited as a truly indigenous species. Mr. Christy believes that in Essex it is more abundant than any other tree except, perhaps, the elm ; a statement which will no doubt come as a surprise to many. That it is truly indigenous is proved by geological evidence collected principally by the late Mr. Clement Reid, its nuts having been identified from four different Quaternary deposits, in Suffolk, Cambridgeshire, and the Lea valley. The charcoal of its wood has also been identified by Mr. A. H. Lyell from three Roman sites in England. Mr. Christy has been at great pains to sift all the available evidence from the several counties where the tree occurs, so as to determine whether or not it is to be regarded in each case as a true native. Being essentially a woodland tree, he assumes it to be indigenous where it is reported as forming ancient woods of considerable extent, but not where it occurs

sparingly in hedges or as scattered specimens. The result is to show its natural range as confined to about a dozen counties in the south-east of England, its northernmost limit being in South Norfolk, its westernmost in Oxfordshire or Hampshire, with a possible extension north-westward towards Warwickshire and Worcestershire. The reasons for this distribution are somewhat obscure, for the tree flourishes on the most diverse soils, and though it is not found on the tops of elevated chalk downs, this is probably due rather to its dislike of such exposed situations than to any aversion to chalk as such (apart from its impenetrability). It is said, however, to prefer fairly deep and moist soils, such as deep loams or sands rich in humus. It frequently occurs in association with the oak, which forms the overgrowth, while the Hornbeam, being everywhere coppiced, forms the undergrowth. May not the restriction of the natural range of the tree to the south-eastern counties be merely due to its comparatively late arrival, geologically speaking?

Temperature Gradient in Petroleum Wells of the Carpathians.

The well-known geographer, Henryk Arctowski, has lately made careful observations of the increase of temperature with depth in various deep borings for petroleum in the Polish Carpathians, and the results are of considerable general interest when compared with those obtained in other parts of Europe and America. An account of the observations has been given by M. Arctowski in Communication No. 7 of the Institut de Géophysique de l'Université de Léopol (Lwów). In the first part of the paper he discusses the apparatus used and the degree of accuracy to be assigned to the results. The depths at which the successive readings were taken were determined by the revolutions of a wheel one metre in circumference, over which the steel wires supporting the thermometer were passed; and subsequent tests at the Belgian Service des Poids et Mesures indicated that the error of length thus obtained was certainly less than 1/1000. Again, the extensibility of the wire was proved by experiment to be only 1·5/1000 under a weight far greater than that actually employed. The thermometers used, seventy in all, were of various types, some not altogether satisfactory, but as three were used for each determination, the comparison thus afforded supplied the necessary check. Certain desiderata were kept in view in selecting the wells in which the determinations were made, *e.g.* that the tubes should be in good condition; that the well should have been abandoned for some time and should be as nearly dry as possible; that the escape of gas should be reduced to a minimum; and that the geological relations should be known with as much precision as possible. The paper records the conditions at each of the ten wells experimented on, and tabulates the results obtained. Afterwards certain conclusions are drawn as to the depth to which surface influences such as the annual range of temperature penetrate, the value of determinations effected actually in the petroleum, the effect of the gases discharged on the observed temperatures, and the precise forms of the thermal gradients obtained. The most generally interesting result is the remarkable analogy brought out between the geo-thermal conditions in some of the Carpathian wells and those of the Appalachians in America, as established by recent observations of C. E. van Orstrand. This shows that certain conclusions relative to the stability of the Earth's crust put forward by R. A. Daly on the assumption of a different thermal gradient for Europe and America must be received with caution, and that marked differences exist between different parts of Europe as we pass from one geological region to another. The thermal

analogy between the Appalachians and Carpathians (regions of geologically different age) may be due to the circumstance that both appear to be marked by a defect of gravity and both are formed of folded sedimentary strata of considerable thickness. Some of the irregularities in the thermal gradient are no doubt due to the passage from one geological formation to another at a given depth, but others may be the effect of escaping gases. While this seems generally to be in the direction of lowering of temperature by expansion, in certain cases the gases may have an original temperature sufficient to cause a *heating* of the upper parts of the wells. But the problems involved are exceedingly complex, and many more data must be collected before they can be satisfactorily solved.

An Early Austrian Cartographer.

The work of a hitherto unknown Austrian cartographer is described by Dr. F. Popelka in the *Mitteilungen der Geographischen Gesellschaft in Wien*, 66, Nos. 4–12. The most important sixteenth-century cartographer for Inner Austria was Wolfgang Lazius, whose atlas of the Austrian hereditary lands appeared in 1561. The works of the Nuremburger, Augustin Hirschvogel, are now known only from copies. Lately, however, a bundle of 109 folio leaves has been found in the Landesregierungsarchiv in Graz, consisting mainly of topographical sketches. These were the work of Johannes Clobucciarich, probably a Slovene or Croat, who was Prior of the Augustinian Monastery at Fürstenfeld between 1585 and 1603. Clobucciarich's connection with the Survey of Inner Austria appears to date from 1601. In that year he was travelling through East Styria and the Upper Mürz and Mariazell basins. Between 1603 and his death in 1606 he also visited the rest of Styria, Krain, and Istria. The material he left behind had not all been worked up into its final shape ; it consists of about five hundred topographic sketches for the most part hastily done, but also a few finished detailed drawings. In most cases the scales are not shown and the positions are only approximate. On one a scale is marked, roughly 1 : 110,000 ; and there is a more finished map of the Gulf of Trieste on a scale of 1 : 300,000. These sketch-maps are particularly rich in topographic names, and are valuable as showing the distribution of the German and Slav populations about 1600. The maps show places, rivers, roads, and mountains, the latter hatched to show their form as noted in the panoramic views. These rougher sketch-maps were finally to be checked against each other, combined, and then carefully redrawn on a smaller scale.

AFRICA

The Inscribed Rock at Sierra Leone.

Referring to the account of this rock sent to us by Mr. Fitch-Jones and printed in the *Journal* for August (*ante*, pp. 139–141), Dr. F. Dixey writes to us from the Government Geologist's Office at Zomba, Nyasaland Protectorate, pointing out that it is almost certainly incorrect to speak of the rock in question as a boulder of *syenite*. From his acquaintance with the geology of the Freetown area, and from the fact that many residents in Sierra Leone speak of almost any hard rock as syenite, Dr. Dixey thinks that the chance of the boulder being anything else than the common norite (hypersthene gabbro) of the area is quite negligible. The distinction is of importance when it is remembered that true syenite does occur some distance to the north-west, in the Los islands, so that a mistake in the description of the rock might easily cause some confusion.

Mr. Fitz-Jones writes to point out that the word transcribed "Westvpies" in the article in question should no doubt be read "Westvries," *i.e.* West Friesland.

Immigrant Races in the Lake Region of Central Africa.

The second Frazer lecture in Social Anthropology was delivered at Cambridge in 1923 by the Rev. John Roscoe, its subject being "Immigrants and their Influence in the Lake Region of Central Africa" (Camb. Univ. Press, 1924). At the present moment it is possible to distinguish here the traces of at least three different races. The earliest, represented only by stone megaliths and shafts for iron-stone mines, may have belonged to the period when the Stone age was merging into the Iron age. The second race, the Negroes, are still represented almost in their original state by the semi-independent tribes round Ruwenzori and Mount Elgon. These Negroes live in detached groups of families rarely exceeding one thousand in number. No common ruler is recognized, and, with some exceptions, they lead a peaceful life. Their villages are of dome-shaped huts of sticks and grass, and their food consists of millet porridge and some vegetables. Most of the agricultural work is done by the women, who also make rough pottery. In marriage clan exogamy is the rule, and descent is patrilinear. The dead were once thrown out into the bush, and sometimes certain portions of the body were brought back and eaten. The later and more ceremonial methods probably arose from a belief in a future life, which required the propitiation of the ghost. The invaders, on the other hand, were all pastoral tribes, coming from the north or north-east, probably connected with the Gallas. Among the Banyankole, the most conservative, the social customs were entirely framed in the interests of the cattle. Fear lest by sympathetic magic the herds would be harmed forbade the eating of vegetables, the manual labour of women, or the condoning of immorality. The limited milk-supply also encouraged polyandry, and discouraged polygamy. At first the new-comers ignored the agriculturalists, but gradually they forced them into servitude. The Bakitara now permit marriage with the Negro population, which has resulted in the introduction of vegetable foods, and among the latter the imitation of the pastoralists' marriage customs and the keeping of cattle. In time the nomads settle down in villages, while the herds wander in the neighbourhood. Under these conditions, and the introduction of land taxes, the power of the chiefs has increased. Among the Baganda the dividing line no longer exists. Land has taken the position formerly occupied by cows. A powerful king, with a capital and a system of courts, rules over districts in charge of chiefs. The men, retaining their dislike of tillage, are artisans and warriors. Polygamy is universal, but though a man's wives are now his own property, clan socialism still holds in other respects. A great advance in religion has led to the development of an elaborate system of gods, temples, and priests. The coming of Arab traders about 1840 introduced sanitary and building reforms, and was on the whole beneficial. The British have brought new religious ideas, arts, and crafts, and are encouraging the natives to develop the commerce and administration of their country.

AMERICA

A Supposed Danish-Portuguese Voyage to Greenland in the Fifteenth Century.

Considerable interest has been aroused by a paper read at the Congress of Americanists, at its meeting this summer at Göteborg, by Dr. Sophus

Larsen, Chief Librarian at Copenhagen University, in which the writer brought forward reasons for believing that a joint Danish and Portuguese expedition to Greenland was carried out some years before the discovery of America by Columbus. According to the scanty reports of the paper yet available, Dr. Larsen based his theory chiefly (1) on statements by Erik of Pomerania, whose wife was sister to Prince Henry the Navigator, to the effect that the Portuguese were proposing to send a joint expedition to the Polar seas to explore a new way to the East by a northerly passage, and that ten years later, in the reign of Christian I. of Denmark, such an expedition was actually carried out under the joint command of Admirals Pining and Pothurst; (2) on a letter written in 1551 by the Burgomaster of Kiel to Christian III., containing the statement that a map published in Paris showed that Pining and Pothurst had really reached Greenland, and there fought with Eskimo from the opposite shores. Reference is also made to a globe of 1537 and map of 1534 as containing confirmatory evidence. It is of course impossible to express any definite opinion on this theory until the full evidence in its favour is available, but it is difficult at the moment to avoid a suspicion that the reports quoted might have no further foundation than a confused memory of the accounts of Greenland by Claudius Clavus early in the 15th century, coupled with a knowledge of the actual Portuguese expeditions made subsequently by the Cortereals to that part of the World. It was supposed by the editors of Clavus—Björnbo and Petersen—that that Danish cartographer may have himself made a voyage to Greenland, and so obtained the material for his description.

AUSTRALASIA AND PACIFIC ISLANDS

Tasman's Visit to the Coast of Tasmania, 1642.

When Tasman touched the east coast of Tasmania in 1642 he attempted a landing by means of the ship's boats on the shore of what is now Prince of Wales Bay (an indentation at the western end of North Bay), but was prevented by the violent surf. The chief carpenter, Pieter Jacobsz, was therefore ordered to swim ashore with a pole and flag, which he set up successfully as a symbol of possession. The spot was marked by four tall trees in a crescent, and was situated in an inlet bearing W.S.W. from the ships. To mark this event a monument has lately been erected, under the auspices of the Royal Society of Tasmania, near the extreme head of Prince of Wales Bay. A discussion has however arisen whether the spot selected is really that on which the carpenter set up the flag, the argument being that this would have been invisible from the ships from the position of their anchorage, as shown in the sketch accompanying Tasman's Journal and reproduced in Prof. Heeres' edition. This is evidently drawn with care and shows the spot on the shore where the flag was raised as in full view of the ships, a condition which would be met by a position on the *north* shore of the bay. Moreover, the approach to the head of the bay is barred by a reef, across which it is considered unlikely that Tasman should have ventured; and again, the ground at the head of the bay is flat and not sloping as described in Tasman's Journal. These considerations were put forward at a meeting of the Royal Society in December last (*Papers and Proceedings*, 1923, p. 166), and as a result it was decided that the wording of the inscription on the monument should be changed from "at this spot" to "near this spot." The above arguments seem to have some force, but it is hardly possible to arrive at a definite conclusion on the evidence of the sketch in the Journal, the ships being shown

thereon on a greatly exaggerated scale, and it would be rash to suppose their position (on which a good deal depends) defined with minute accuracy by the drawing.

POLAR REGIONS

Lauge Koch's Plans for a New Arctic Expedition.

Through the courtesy of the Foreign Office we are informed that Lauge Koch, who described the "Jubilee" expedition to Northern Greenland carried out by him in 1922 at a meeting of the Society in March last (*Journal*, vol. 64, pp. 6 *et seq.*), is already planning a new expedition for research in the Arctic. Its objects will be mainly geographical and cartographical, and the field of work will be Grant Land and other parts of Arctic Canada, where the explorer proposes to investigate and map the mountain range which he regards as the continuation of those explored in Northern Greenland, these being in turn, geologically, a section of a great arc running thither from Wales through Scotland, the Shetland Isles, and Spitsbergen. Mr. Koch expects that the working up the results of his recent expedition will occupy a considerable time, so that his plans for the new expedition are still in the preliminary stage only.

HISTORICAL AND ECONOMIC GEOGRAPHY

Inter-racial Problems and White Colonization in the Tropics.

The above was the subject of the Presidential Address given by Prof. J. W. Gregory to Section E (Geography) of the British Association at Toronto this summer. Inter-racial problems, he pointed out, have been complicated by the great increase in the population of the world. This increase has been most rapid in Africa and Asia owing to the reduction of internal war, pestilence, etc., by European administration. Immigration restrictions in America, Australia and South Africa have closed natural outlets for Asiatic expansion. Can Europe continue her work until Africa and Asia are ready to co-operate with her, and finally replace the older forms of servitude by sympathetic alliance, or has she, as did Portugal in the sixteenth century, taken on tasks beyond her power? Practically within the last century, one-third of the inhabitants of the world—the white or European race—have come to rule eight-ninths of its area. With regard to future racial distribution of the three primary races, there are three ruling geographical principles: first, the population must be scanty in the colder regions, and in the dry deserts, except in limited irrigated areas; secondly, the tropical regions have hitherto been the home of the coloured races, and the white race has been mainly restricted to the temperate zone; thirdly, where races live side by side, the more primitive will normally outlive the other wherever the struggle for existence is keen. For these reasons, the frigid zones, dry deserts and tropical plateaus above 12,000 feet above sea-level will be sparsely populated, and white colonists will be unable permanently to occupy land near the overcrowded parts of Asia or Africa. The white race, living in the same land as the coloured, can either amalgamate with it by miscegenation, can reside without fusion, can disfranchise the coloured population as state wards, or can segregate the races in separate countries or communities. Whether or not racial fusion is desirable, the strong intellectual aversion to it in North America and Northern Europe will prevent its adoption there. In the United States permanent distinct co-citizenship has failed to remove racial conflict: the formation of the south-east States into a group with certain powers of home rule may be the final solution. In South Africa, segregation

appears to be the only plan by which the country can be developed as a permanent home of Europeans. The problem in Australia is the possibility of the occupation of the whole continent by Europeans. Against the "traditional view" that Northern Australia is unsuited to be the home of white men, Prof. Gregory would advance present-day medical opinion, which holds disease, not climate, to be the enemy. He holds that there is no reason to regard the climate of considerable areas of tropical Australia as more uncomfortable than that of Calcutta, and that the effects of a high wet-bulb temperature, monotony of climate, and of the actinic rays of the sun are generally exaggerated. In Panama, the ten thousand whites in the construction camps enjoyed as good health as they would have done in the United States. Queensland, a large part of which is tropical, has a lower death-rate than any European country. Its sugar industry has greatly increased since the exclusion of coloured labour. The failure to develop the Northern Territories, which was evident before the initiation of the "White Australia" policy, is due to poorness of soil, unsuitable distribution of rainfall, and inaccessibility. This last could be removed by the building of the Mid-Continental line to South Australia. The conclusion that the white man may colonize any part of Australia will permit the establishment of an outlet and a home for the European race, and will assist that separate existence as a whole of the three main races which, with opportunities for individual association and co-operation, holds out the best hopes for the future. Such, in brief outline, are the main points in Prof. Gregory's address. But the subject is a controversial one, and it will be long before the above views are likely to meet with general acceptance.

OBITUARY

B. Glanvill Corney.

By the death, in London, of Bolton Glanvill Corney, I.S.O., on September 29, the Society as a whole, and especially its officers, have suffered severe loss.

He was born at Barnes on 10 December 1851, the only child of Bolton Corney—once well known as an antiquary, a bibliophile, and for his literary squabbles with Panizzi and Disraeli—and of Mary, daughter of Admiral Pridham. The son was educated privately in France, England, Germany, and eventually at St. Thomas' Hospital. Something of the characters of both parents was reproduced in the son, but in a form greatly altered and widened, both by his medical studies and by the great love of the sea and of travel which the son doubtless inherited from his sailor grandfather.

In 1876 Glanvill Corney went, with his wife, to the then new Crown Colony of Fiji, as Surgeon Superintendent of the Gilbert Islanders and other Melanesians who were being taken as labourers to Fiji. There the whole of his official life, till he retired in 1908, was spent in various posts connected with the health and welfare of the island folk, native and European alike.

At first he devoted himself to intimate and truly sympathetic study of the Fijians; and, travelling in the recruiting ships, he visited for the same purpose the Gilbert, Solomon, and other more distant islands. Moreover, he spent his leave in similar study in Tonga, Samoa, Tahiti—and in Australia.

After he was definitely appointed Chief Medical Officer of Fiji in 1887, he used the very great and detailed knowledge which he had already gained in thoroughly organizing the island medical service; and he employed his

periods of leave in travelling further afield, bringing his medical knowledge up to date, and—at the British Museum, the Public Record Office, and more especially in the Spanish Archives, and elsewhere—in unearthing the forgotten South Sea lore buried in the dispatches and reports of the old Spanish and Portugese governors and voyagers. Probably no man has ever stored in his brain so many and such detailed facts concerning the South Seas in all past and present aspects. His innate passion for detail and accuracy, his wide knowledge of many languages, both those learned as a boy and those imbibed in the course of his life's work, alone made this great garnering possible.

An habitual shyness, due to the loneliness of his boyhood, generally prevented him from declaring his knowledge until he was asked for it; but when once called upon, his great natural kindliness of disposition made him pour out his information in most generous measure, and even induced him to take any amount of pains to ascertain facts which he did not happen to know but clues to which he had pigeon-holed in innumerable note-books—*cahiers*, he always called these.

Many of his results had appeared, even during his years of service, in Government publications and in the Transactions of various medical and other learned societies. Perhaps the most remarkable of these was the Report—for which he was largely responsible—on the decrease of the Fijian native population. But his widely scattered papers: on 'Epidemic Diseases in Polynesia,' on 'Epidemic Cerebro-spinal Meningitis,' on 'Dengue Fever,' on 'Leprosy Stones,' on the 'Periodic Occurrence of the Balolo,' and many others, record facts for the study of which he perhaps had, and used, greater opportunity than has fallen to the lot of many other men.

But it was during the leisure years after retirement that he produced—but always only when asked to do so—most of his results. Among these may be mentioned four volumes of historical lore for the Hakluyt Society (on the Council of which Society he served), and most of the Pacific sections of the Handbooks prepared, during the War, for the Foreign Office.

He joined the Royal Geographical Society in 1912, and soon after served for several years on its Council. The Back Grant was awarded to him by the Society in 1923. Characteristically, he never read a paper before the Society, but joined freely in the discussions after other peoples' papers on subjects with which he was familiar. He gave exceptionally valuable aid to the Permanent Committee on Geographical Names; and, above all, he always most readily supplied answers to the many questions put to him by the officers of the Society, on the subjects which he had so thoroughly made his own. It is understood to have been his own wish that the more important of his unpublished notes should be preserved for reference in the Society's Library.

Seldom does a man so little known to the general public pass away so much regretted by many who had grown accustomed to looking to him for help in matters concerning the South Seas, and so regretted, too, by his intimate personal friends.

E. im T.

CORRESPONDENCE

"More Talk about Hannibal."

THERE is a story that Napoleon said Hannibal must have crossed the Alps near Monte Viso; and when somebody remarked that this was not in accord-

ance with the evidence, he replied, "So much the worse for the evidence." Mr. Freshfield follows Napoleon.

Take, for instance, the evidence of Polybius. He was born in Hannibal's lifetime; and he says (iii. 48. 12) that before writing his account of Hannibal's passage of the Alps, he went over the ground himself and inquired of eye-witnesses. His evidence, surely, is worth something; and he says (iii. 54. 2, 3) that there was a view of Italy from the summit of the pass, and that Hannibal addressed his men there, and pointed to the plain of the Po spread out in front of them. There is a wide view of the plain of the Po from the Col de la Traversette, but none at all from the Col d'Argentière. Having committed himself to the Argentière, Mr. Freshfield writes: "Classical historians were in the habit of lightening their narratives by putting dramatic speeches into the mouths of their leading characters, and I hold that Polybius and Livy were quite capable of using the arrival of the Carthaginian army on the Alpine watershed as an occasion for an appropriate harangue from their leader." If Polybius was capable of saying there was a great view where there was no view, he was capable of saying anything; and his evidence would not be worth discussing. But if his evidence is admitted, we have to choose between his statement that Hannibal crossed a pass commanding a wide view of Italy, and Mr. Freshfield's statement that Hannibal crossed the Argentière, which commands no view at all.

Mr. Freshfield acknowledges that "if a view of Italy is necessary, the Col de la Traversette is one of the few passes which can supply it." But he objects that there is no room for an army to camp near its top. My answer is that Polybius says (iii. 55. 6) that Hannibal camped on a ridge (*rhachis*) on the first night of the descent; and if he camped on a ridge then, he could equally well have camped near the top of the Traversette on the previous night.

Comparing the Traversette with the Argentière, Mr. Freshfield says that the Traversette (9679 feet) is approached from the west by savage gorges and through bare and barren valleys, whereas the western access of the Argentière (6543 feet) lies over gentle, habitable slopes, cornfields, and pleasant pastures. I cannot myself see how these gentle slopes, etc., can be the precipitous gorges which Polybius mentions (iii. 51. 4, 52. 8) at this stage of Hannibal's march—one a little way up the pass and another near the top—and a pass of 6545 feet seems less likely than a pass of 9679 feet to have the previous winter's snow covering the ground in autumn, as Polybius (iii. 55. 1) describes.

Translated literally, Polybius says (iii. 42. 1) that Hannibal crossed the Rhone "when distant, at the camp, about four days' march from the sea." Mr. Freshfield mistranslates this as "four days' march from the camp by the sea," and refers it to "Scipio's camp at Fos." Polybius says (iii. 41. 5) that Scipio disembarked at the eastern mouth of the Rhone. Fos was at the mouth of a canal that was not made until a century later on. And as Hannibal was coming from Spain, the four days' march would probably be reckoned from the western mouth.

Then Polybius says (iii. 47. 1) that Hannibal marched *eastward* after crossing. Mr. Freshfield makes him march *northward*. He says, "Polybius elsewhere asserts that the general course of the Rhone is to the south-west: therefore any one ascending it might easily in his view be trending eastward." But where Polybius says that the general course of the Rhone is south-west (iii. 47. 2, 3) he says that its course on the north side of the Alps is west. He was not likely to distinguish west and south-west in one sentence, and confound them in the next.

Again, Polybius says (iii. 49. 6) that Hannibal marched up the Rhone to its confluence with a river called the Scoras. Livy (xxi. 31) calls the river the Arar; and in this part of his history he is following Polybius almost word for word. I think Livy must have mistaken Scoras for Saucona, which was an old name for the Arar. Mr. Freshfield—like many other people—thinks the manuscripts are wrong, and have Scoras by mistake for Isaras in Polybius and Arar by mistake for Isara in Livy. I do not think that either of these mistakes was likely to be made, and there certainly are long odds against the double event. However that may be, Mr. Freshfield gives a further reason: "The geographical description given by Polybius of the district in question [between the Rhone and the other river] corresponds in its details with the country north of the Isère, while it cannot reasonably be forced into any correspondence whatever with that enclosed between the Rhone and the Durance." He must surely have forgotten what Polybius says. This "geographical description" consists of three sentences. In iii. 49. 5 Polybius says that it was "a populous and fertile district"—a description which is just as applicable to the country between the Rhone and the Durance or the Rhone and the Saône as to the country between the Rhone and the Isère. In iii. 49. 6, 7 he says that the district was of the size and shape of the Delta of the Nile, and had the Rhone on one side and the Scoras on the other, but a range of mountains instead of the sea for the third side; and he describes these mountains as "hard to approach, hard to enter, and, so to speak, almost inaccessible." According to Mr. Freshfield, this description corresponds with the Mont du Chat, between the Isère and the Rhone, but "cannot reasonably be forced into any correspondence whatever" with the Alps between the Durance and the Rhone.

Livy says (xxi. 31) that instead of going straight from the confluence to the Alps, Hannibal turned to the left into the territory of the Tricastini. Mr. Freshfield says that he sees no serious difficulty in Hannibal's turning to the left at the confluence of the Rhone and the Isère, as the Drôme valley would be a straight road to the Alps, and the Isère valley would be relatively on his left. Quite so. But the difficulty is that it would not take Hannibal into the territory of the Tricastini.

In that part of his article Mr. Freshfield seems to have written rather hastily. He says, "Mr. Torr next asks us to believe that Livy was mistaken in suggesting that it was fear of a flank attack," etc. Livy does not suggest this: it is a suggestion of a modern writer. After this he says, "Mr. Torr gets his 200 miles by assuming Hannibal marched as far as Lyons." I have not assumed it. I have merely stated what the distance would have been if Hannibal had done what Livy says (xxi. 31) he did, namely, marched up to the confluence of the Arar and the Rhone, which confluence is at Lyons. He also says, "Mr. Torr also altogether fails to realize the character of the Durance, at one time a raging torrent, at another easily fordable." I happen to have seen it in both states, and I take Livy (xxi. 31, *tum imbribus auctus*) to mean that it was then in flood.

On the same page he uses very strong language about a suggestion which I made. Livy and Appian say that Hannibal and Hasdrubal crossed the same pass. Varro said that they crossed different passes. But this is not in any of his extant works: we have it only at second hand through Servius. The problem is, Was Varro really at variance with Livy and Appian, or has Servius misquoted him? There is evidence of an interpolation in a similar quotation from Polybius, and I said, "Similar interpolations may be suspected

here." I cannot understand why Mr. Freshfield is so angry at my questioning the text of Servius, for his whole Isère theory is based on alterations in the text of Livy and Polybius.

At the close of his article he has some very sound remarks to the effect that study of the texts is not enough ; there must be study of the country. The converse is also true, and it seems a waste of time to pitch on certain bits of country as suitable for Hannibal's march when there is no evidence that Hannibal went anywhere near them. Moreover, his own knowledge of the country does not seem to be quite adequate when he asserts that "hard to approach, hard to enter, and, so to speak, almost inaccessible," suits the Mont du Chat and does not suit the mountains further south.

CECIL TORR.

Climatic Continentality and Oceanity.

With regard to Mr. D. Brunt's paper on Dr. Spitaler's calculation of the climatic continentality and oceanity (published in the July number of this *Journal*) I may be allowed a few words, as I have had the occasion to prove the value of these formulæ when trying to work with them.

Nowhere we find stated in Dr. Spitaler's papers, it is true, but we are led to believe that his formulæ will give good results for any month. This naturally is not the case, as Mr. Brunt already has stated, and we have to be sorry for it, for were the formulæ really perfect they would be a very good instrument in the hands of the meteorologist. For they would enable us

(1) To calculate the monthly mean temperature for any latitude, if only the "geographic" continentality (n in Mr. Brunt's paper) of this parallel of latitude is known. For this purpose we could write the formula

$$t = (c + \mathrm{CS})(1 - n) + (k + \mathrm{KS})n$$

the only variable in this equation being S, the monthly radiation, the annual radiation S_0 being a constant for a given latitude. As S has its extreme values in June and December, the months would give the maxima and minima of temperature too, which however is nearly nowhere the case. Therefore the formula cannot be used for this purpose.

(2) To calculate the "climatic" continentality of a given circle of latitude or of a given place (Mr. Brunt's n_c and n_s respectively) for every month and for the whole year. Now the formula would appear in the shape

$$n_{c,s} = \frac{t - c - \mathrm{CS}}{k - c + (\mathrm{K} - \mathrm{C})\mathrm{S}}$$

where the continentality would be proportional to t and roughly inversely proportional to S. The latter would surely outweigh the former, thus making the continentality greatest in winter. It is clear that this kind of continentality would best be called "radiation continentality," the term "climatic continentality" being a little too boastful. An equation

$$\text{radiation} = \text{climate}$$

or even

$$\text{temperature} = \text{climate}$$

would be a false one: thus we cannot call a "radiation" or a "thermal" continentality a "climatic" one. As far as I am aware, it has not yet been even tried to define a really "climatic" continentality, and I think that we meteorologists should use precise terms in order not to make other people, for example, geographers, believe that we have succeeded in finding a really climatic definition for continentality while we have not yet.

Considering this, I feel compelled to oppose a statement in Mr. Brunt's paper. He writes, "By this means (by applying the formula) we should find

a value n_e of n which should give to a fair degree of approximation the fraction of the parallel of latitude ϕ which is covered by land" (p. 46), but he expressly states that some comparisons worked out by himself did not agree with Dr. Spitaler's values. Nor could we, I think, expect it, for Dr. Spitaler's, or rather Mr. Baldit's, n is the "geographic" continentality, while the n_e and n_e are the "radiation" continentality.

The lag of temperature behind radiation which has been referred to by Mr. Bonacina in the discussion has not been taken into consideration by Dr. Spitaler. But already more than thirty years before it was calculated, for continental and oceanic climate separately, by another German author, Wilhelm Zenker. But I think Dr. Spitaler was right not to use Zenker's calculations, for they need a thorough revision, as I believe.

The different surface covering of land on which so much stress was laid by Mr. Bonacina has been taken into consideration by Dr. Spitaler, inasmuch as he has based his calculations on the "mean" thermal properties of all the substances which make up the surface of the continents, as has been the custom to do in all investigations of this kind. Naturally this is a broad generalization, and may apply to a whole parallel of latitude, but not quite as well to a single place. Therefore Mr. Bonacina is partially wrong when stating that the supercontinentality in Eastern Siberia is due principally to the snow covering in winter. Certainly this is the case in nature, but not in Dr. Spitaler's formula, which can make use not of the difference in the surface covering between summer and winter, but only of the enlarged annual temperature amplitude when applied in the shape given by Mr. Brunt on p. 46. Dr. Spitaler expressly states that the constants for ice and snow in his formulæ may have values very different from those calculated for ordinary solid soil.

But in spite of the shortcomings of Dr. Spitaler's formulæ I cannot agree with Dr. Simpson when he says that their value is practically nil for the meteorologist. I think they will be most valuable when used for calculating n_e and n_e for January, July, and the year separately. Thus they are the first step to our being able to trace the variations of a kind of climatic continentality through the different seasons, while, when made use of in the shape quoted by Mr. Brunt (which, too, has served in constructing Dr. Swoboda's charts) they will give little or nothing more than the annual temperature amplitudes. For proving the truth of this statement I may perhaps be allowed to quote, from a paper of mine,* an example regarding the influence of Lake Baikal on the climate of its surroundings.

		n_e for January.	July.	Year.
Stations on the shore of Lake Baikal ...	Ushkaniy Island ...	0·86	0·49	0·56
	Turki Lighthouse ...	0·97	0·54	0·77
	Golo-Ustnoye	1·11	0·44	1·09
Stations distant from the shore of Lake Baikal	Kirensk	1·09	0·92	1·13
	Tunka	1·45	0·77	0·88
	Verkhne-Udinsk ...	1·56	0·81	1·09

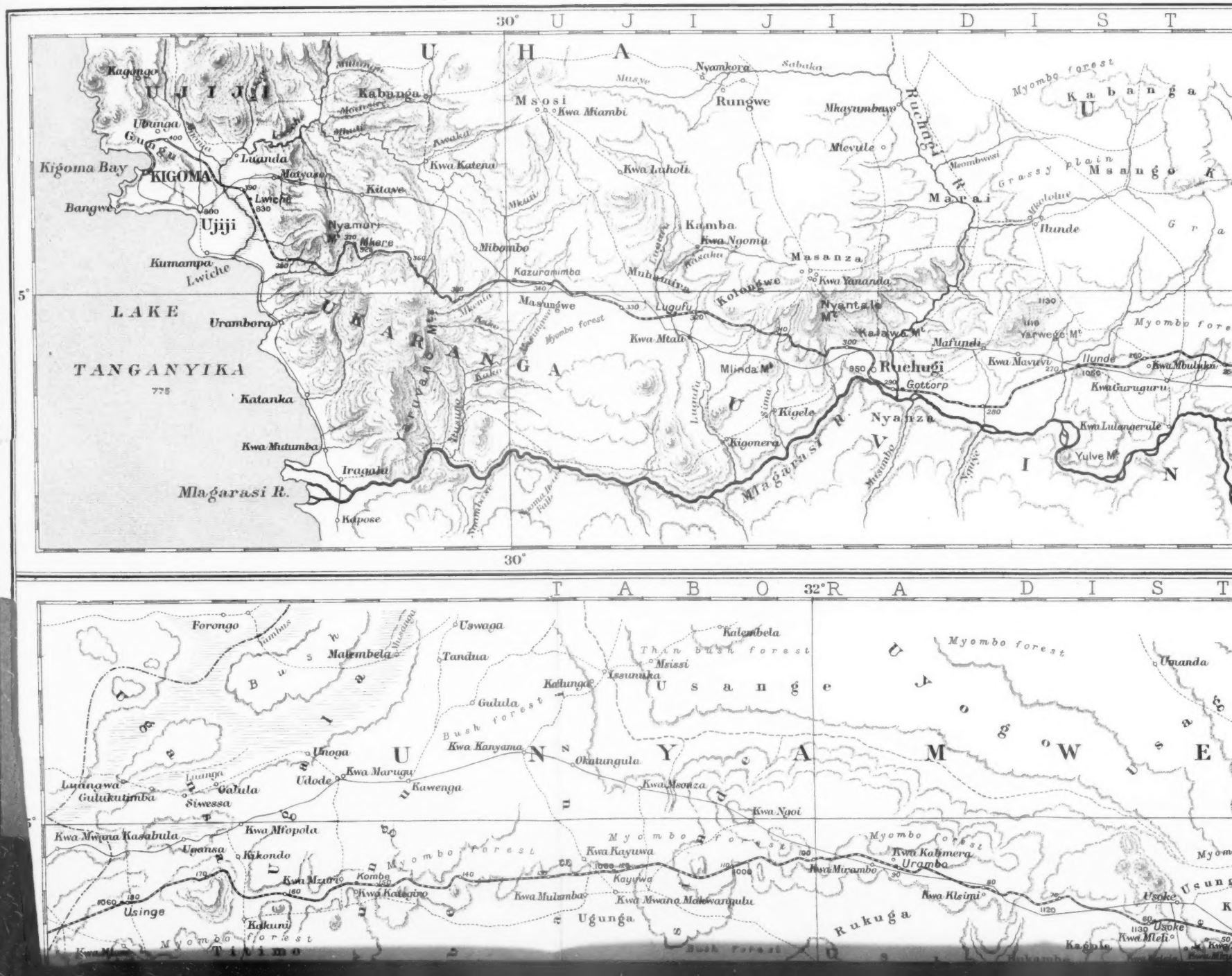
We see here, especially in winter, an island of relative oceanity in the midst of the greatest continental mass of the Earth clearly proved by the formula.

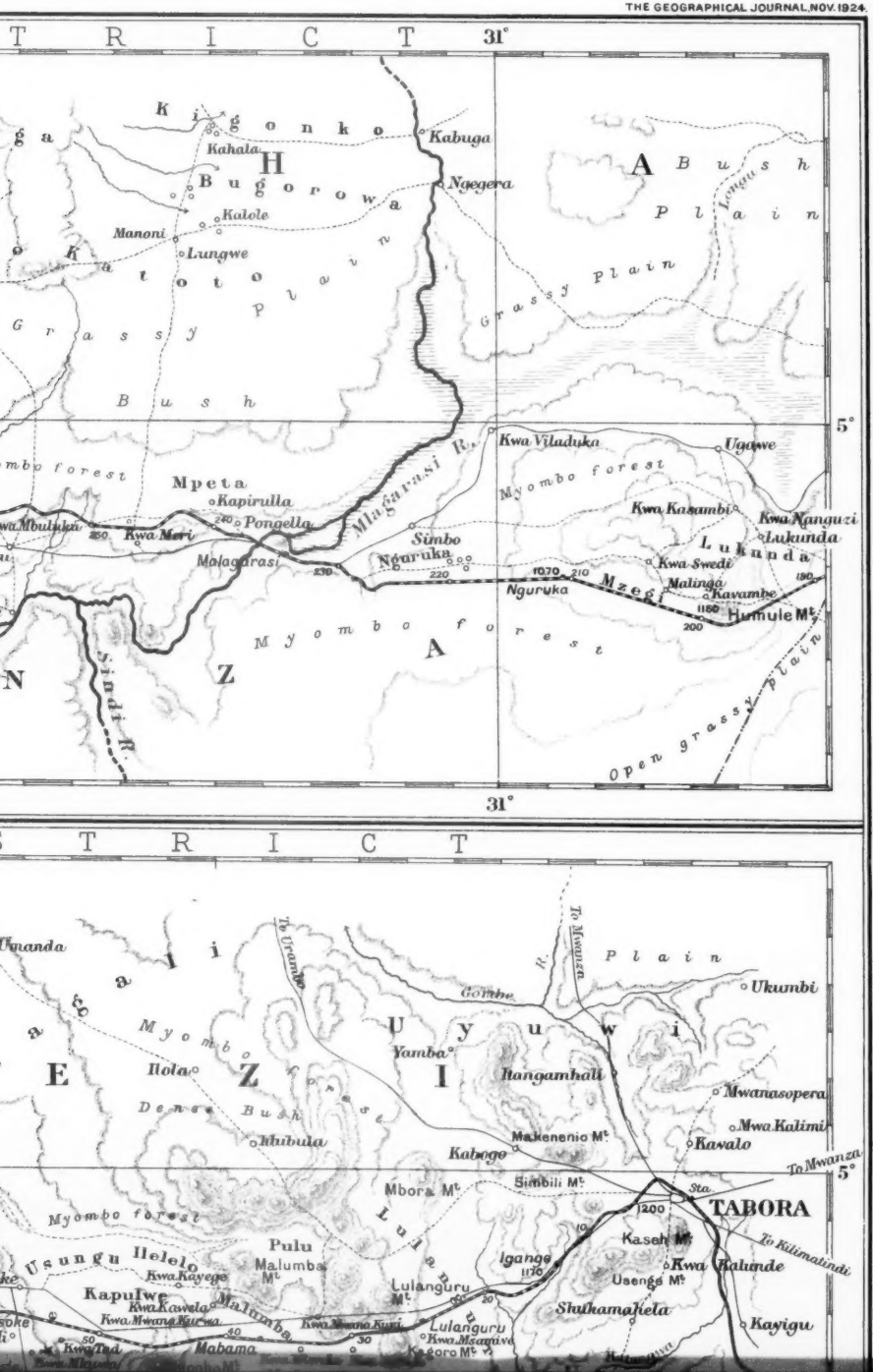
CARL HANNS POLLOG,
Munich.

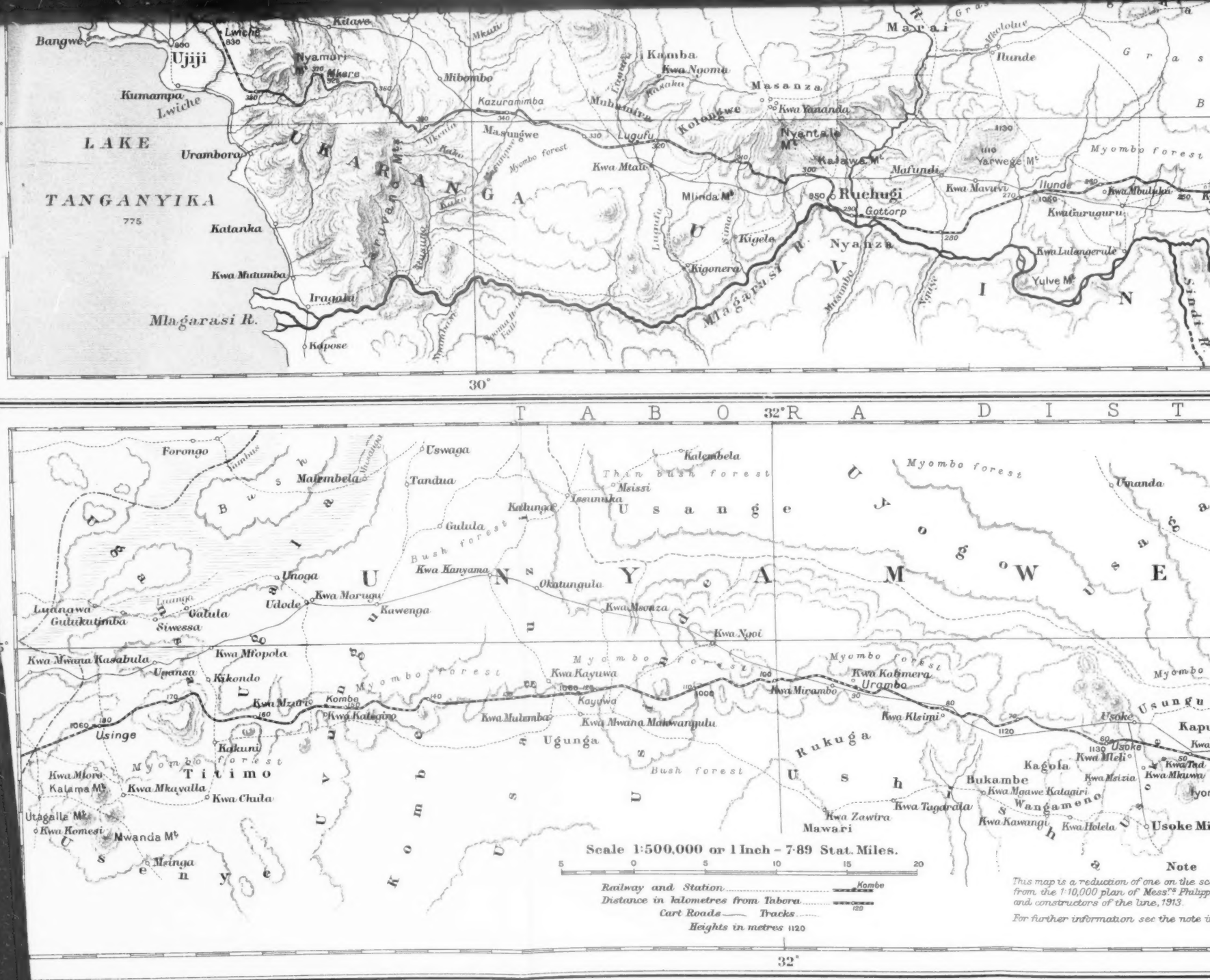
* "Untersuchungen von jährlichen Temperaturkurven zur Charakteristik und Definition des Polarklimas." Will appear, in September, in the *Mitteilungen der Geographischen Gesellschaft München.*

TANGANYIKA TERRITORY

Part of the CENTRAL RAILWAY from TABORA TO KIGOMA




T R I C T
31°
Kigonko
Kabuga
Kahala
Bugorowa
Ngegera
Kalole
Manoni
Lungwe
Katotoo plain
Grassy
Bush
A Bush Plain
Longuza
Grassy plain
5°
Kwa Viladuka
Ugowe
Mpeta
Kapirulla
Pongella
Mbulika
Kwa Mori
Malagarasi
Simbo
Nguruka
Mlagarasi R.
Myombo forest
Kwa Kasambi
Kwa Nanguzi
Lukunda
Kwa Swedi
Malinga
Kawambe
Humule Mt.
Mzesi
1070
210
220
230
240
250
180
1180
200
Myombo forest
Sindi R.
Open grassy plain
31°
T R I C T
Unanda
Myombo forest
Dense Bush
Ilola
Mlubula
To Uramba
To Mwanza
R.
Plain
Ukumbi
Gombe
Yamba
Uyuwi
Rangamhali
Mwanasopera
Mwa Kalimi
Kawalo
Makenenio Mt.
Kabogo
To Mwanza
5°
Simbili Mt.
Mbora Mt.
Sta.
TABORA
Myombo forest
Pulu
Malumba Mt.
Usungu Ilelelo
Kwa Kayego
Kapulwe
Kwa Kawela
Kwa Mwana Kuwa
Kwa Mwana Kuwa
Lulanguru Mt.
Lulanguru
Kwa Msamwe
Kageoro Mt.
Mabama
Kwa Rad
Kaseh Mt.
To Kilimatinde
Kwa Kalunde
Usenga Mt.
Shukamahela
Kayigu
Iganga
1170
Lulanguru R.



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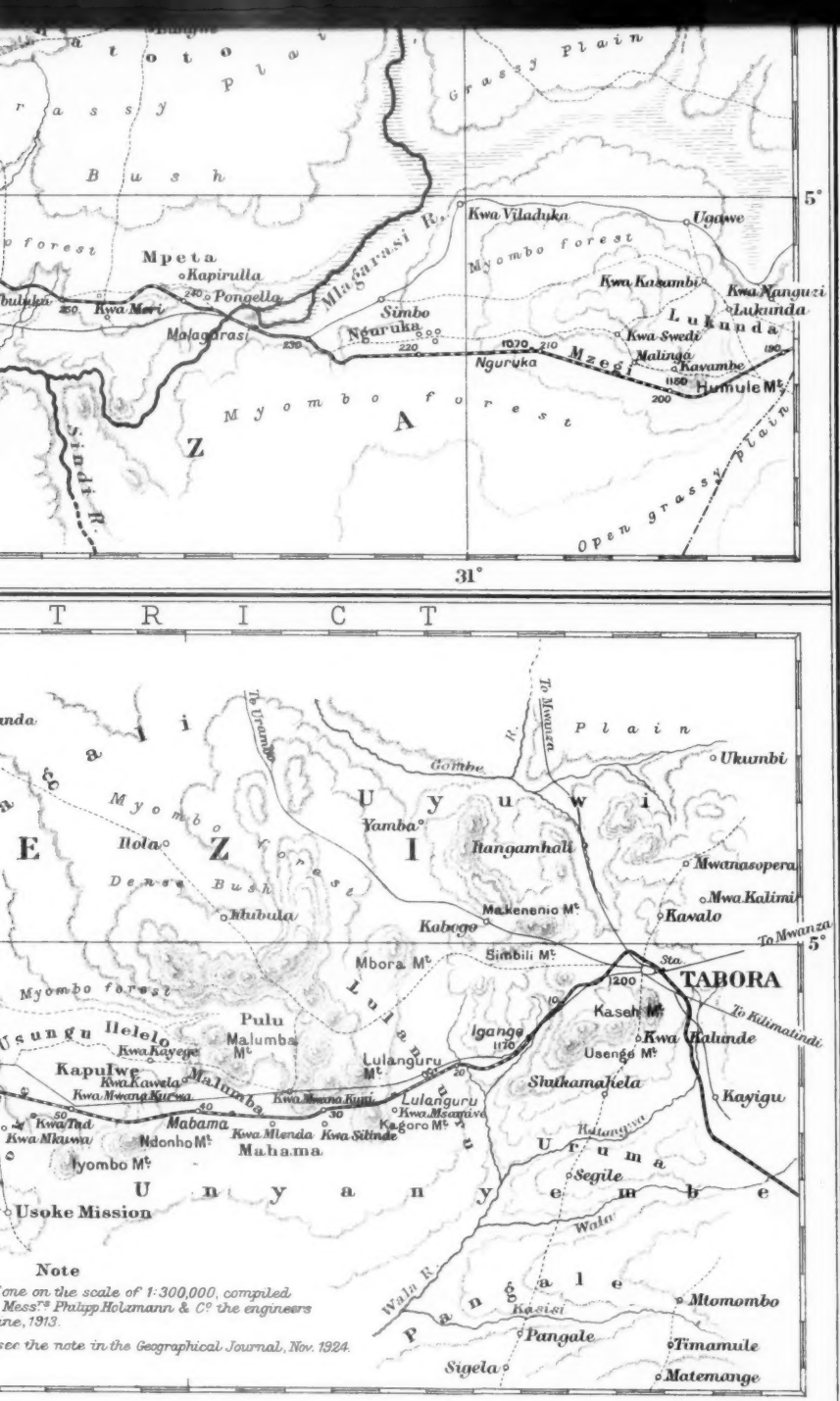

CENTRAL RAILWAY
TANGANYIKA TERRITORY